ENCLOSURE I

# Commonwealth of Virginia

# State Implementation Plan Revision: Regional Haze Five-Year Periodic Report 2008-2013

**Final**

## Executive Summary

The Clean Air Act mandates requirements for the protection of visibility in class I federal areas. On July 1, 1999, the US Environmental Protection Agency (EPA) finalized the Regional Haze Rule (RHR) (66 FR 35714). The rule calls for state, tribal, and federal agencies to work together to improve visibility in 156 national parks and wilderness areas.

States are required to develop and implement air quality protection plans (state implementation plans, or SIPs) to reduce pollution that causes visibility impairment. These plans establish goals and emission reduction strategies based on trends from various sources, including area source emissions, mobile source emissions (both on-road and non-road emissions), biogenic emissions, and wildfire and agricultural emissions.

In developing the Virginia Regional Haze SIP, which was given partial approval by EPA on 6/13/2012 (77 FR 35287), the Commonwealth of Virginia prepared a long-term strategy and examined the possible application of Best Available Retrofit Technology in order to establish reasonable progress goals for the Virginia's two class I areas, James River Face Wilderness Area and Shenandoah National Park. The predicted reductions in visibility impairment were expected to result from implementation of existing and planned emission control programs. This document is intended to address the requirements of 40 CFR 51.308(g) requiring periodic reports evaluating progress toward reasonable progress goals and covers the years from 2007 to 2012.

Ammonium sulfate is the largest contributor to visibility impairment at James River Face Wilderness Area and Shenandoah National Park, and reduction of sulfur dioxide ($SO_2$) emissions is the most effective means of reducing ammonium sulfate. As such, the majority of the focus with regard to existing and planned emission controls pertains to the largest sources of $SO_2$ emissions. These sources consist of electric generating units (EGUs) and large industrial boilers.

Many of the EGUs within the Commonwealth have installed controls through a number of mechanisms, including the Clean Air Interstate Rule, state programs, and state and federal consent agreements. Reductions associated with many of these mechanisms were used to estimate the 2018 visibility improvements at class I areas. However, since the development of the "Best and Final" emissions inventory for the Regional Haze SIP submittal, additional regulations and actions have been imposed on this source sector. These additional mandates will help ensure that the reasonable progress goals are attained on or before 2018. Moreover, several EGUs have announced plans to either retire units or curtail emissions by converting to natural gas, leading to even more significant reductions in $SO_2$ emissions.

For these reasons, the Commonwealth of Virginia is submitting a negative declaration to EPA specifying that the Commonwealth of Virginia's Regional Haze SIP is sufficient for meeting the requirements outlined in the RHR. Furthermore, no additional controls are necessary, based on this five-year progress report.

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# List of Acronyms and Abbreviations

AoI - Area of Influence
BART - Best Available Retrofit Technology
CAA - Clean Air Act
CAIR - Clean Air Interstate Rule
CAMD - Clean Air Markets Division
CO - carbon monoxide
CSAPR - Cross State Air Pollution Rule
CTG - Control Technique Guideline
dv - deciview
EC - elemental carbon
EGU - electric generating unit
EPA - US Environmental Protection Agency
FGD - flue gas desulfurization
FLM - federal land manager
g/bhp/hr - grams per break horsepower-hour
HAP - hazardous air pollutant
IMPROVE - Interagency Monitoring of Protected Visual Environments
ICI - industrial, commercial and institutional
IPM - Integrated Planning Model
MACT - Maximum Achievable Control Technology
MANE - VU - Mid Atlantic/Northeast Visibility Union
MMBTU - million British thermal units
NAAQS - National Ambient Air Quality Standard
NESHAP - National Emission Standards for Hazardous Air Pollutants
$NH_3$ - ammonia
NMOC - nonmethane organic carbon
$NO_2$ - nitrogen dioxide
$NO_X$ - nitrogen oxides
PM - particulate matter
$PM_{2.5}$ - particulate matter with a diameter of 2.5 micrometers or less (fine particulate)
$PM_{10}$ - particulate matter with a diameter of 10 micrometers or less (coarse particulate)
POM - primary organic matter
ppm - parts per million
ppb - parts per billion
RACT - Reasonably Available Control Techniques
RHR - Regional Haze Rule
RPG - reasonable progress goals
RPO - regional planning organization
SCC - State Corporation Commissions
SCR - selective catalytic reduction
SEMAP - Southeast Modeling, Analysis, and Planning
SIL - significant impact level
SIP - State Implementation Plan
$SO_2$ - sulfur dioxide
tpy - tons per year
TVA - Tennessee Valley Authority
VDEQ - Virginia Department of Environmental Quality
VISTAS - Visibility Improvement - State and Tribal Association of the Southeast
VOC - volatile organic compound

## Abbreviations for Class I Area Monitoring Sites:

BRET1 - Breton Wilderness Area, LA
BRIG - Brigantine Wilderness Area, NJ
CACR1 - Caney Creek Wilderness Area, AR
CHAS1 - Chassahowitzka Wilderness Area, FL
COHU1 - Cohutta Wilderness Area, GA
DOSO1 - Dolly Sods Wilderness Area, WV
EVER1 - Everglades National Park, FL
GRSM1 - Great Smoky Mountains National Park, TN
HEGL1 - Hercules Glade Wilderness Area, MO
JARI1 - James River Face Wilderness Area, VA
LIGO1 - Linville Gorge Wilderness Area, NC
MACA1 - Mammoth Cave National Park, KY
MING1 - Mingo National Wildlife Refuge, MO
OKEF1 - Okefenokee Wilderness Area, GA
ROMA1 - Cape Romain Wilderness Area, SC
SAMA1 - St. Marks National Wildlife Refuge, FL
SHEN1 - Shenandoah National Park, VA
SHRO1 - Shining Rock Wilderness Area, NC
SIPS1 - Sipsey Wilderness Area, AL

# 1. Introduction

This periodic report describes the progress toward meeting the reasonable progress goals (RPGs) set forth in the Commonwealth of Virginia's Regional Haze State Implementation Plan (SIP) as required by 40 CFR 51.308(g).

As determined according to 40 CFR 308(h), no updates to the Virginia Regional Haze SIP need to be made at this time, and no additional controls are necessary during this five-year progress report period.

## 1.1. Background

Regional haze is defined as visibility impairment produced by a multitude of sources and activities that emit fine particles and their precursors and that are located across a broad geographic area. These emissions are transported over large regions, including national parks, forests, and wilderness areas (class I federal areas). The federal Clean Air Act (CAA) mandates protection of visibility, especially in class I areas.

Fine particles may either be emitted directly or formed from emissions of precursors, the most important of which are sulfur dioxide ($SO_2$) and nitrogen oxides ($NO_X$). Particles affect visibility through the scattering and absorption of light, and fine particles - particles similar in size to the wavelength of light - are most efficient per unit of mass at reducing visibility. Therefore, reducing fine particles with a diameter less than 2.5 micrometers ($PM_{2.5}$) in the atmosphere is generally considered to be an effective method of reducing regional haze and thus improving visibility. The most important sources of $PM_{2.5}$ and its precursors are coal-fired power plants, industrial boilers, and other combustion sources. Other significant contributors to $PM_{2.5}$ and visibility impairment include mobile source emissions, area sources, fires, and wind-blown dust.

On July 1, 1999, the United States Environmental Protection Agency (EPA) finalized the Regional Haze Rule (RHR) (64 FR 35714). The rule calls for state, tribal, and federal agencies to work together to improve visibility in 156 national parks and wilderness areas. The rule addresses the combined visibility effects of various pollution sources over a wide geographic region. This wide-reaching pollution net meant that all states, even those without a class I area, would be required to participate in haze reduction efforts. EPA designated five Regional Planning Organizations (RPOs) to assist with the coordination and cooperation needed to address the visibility issue (see Figure 1). Virginia is among those states that make up the southeastern portion of the contiguous United States and therefore participated in the RPO known as VISTAS (Visibility Improvement – State and Tribal Association of the Southeast). VISTAS includes the eastern band of Cherokee Indians as well as the states of Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, Virginia and West Virginia. The Southeastern Modeling, Analysis, and Planning (SEMAP) group, funded by the same ten states originally involved in VISTAS, was formed to address the next phase of ozone, fine particle and regional haze assessment obligations of the member states. The organizational change was implemented primarily as an administrative convenience.


**Figure 1: Geographical Areas of Regional Planning Organizations**

States are required to develop and implement air quality protection plans (state implementation plans or SIPs) to reduce the pollution that causes visibility impairment. These plans establish goals and emission reduction strategies based on trends from various sources, including point source emissions, area source emissions, mobile source emissions (both on-road and non-road emissions), biogenic emissions, and wildfire and agricultural emissions. Under the RHR, states are required to develop, and periodically update, SIPs to reduce visibility impairment with the express intent that by 2064, the visibility in the class I areas will be returned to natural conditions. The rule requires states to establish RPGs, expressed in deciviews (dv), for visibility improvement at each class I area covering each (approximately) 10-year period until 2064. The first SIP, covering the ten-year period from 2008 through 2018, was due December 17, 2007.

States were required to establish baseline visibility conditions for 2000-2004, natural background visibility in 2064, and the rate of uniform progress between baseline and background conditions. The first set of RPGs must be met through measures contained in the state's long-term strategy covering the first ten year period from 2008 through 2018.

The five RPOs worked together to develop the technical basis for these SIPs. Their work products were used to establish monitoring strategies for evaluating visibility conditions, baselines, and trends, and to develop long-term (10-15 year) strategies for making "reasonable progress" toward eliminating all anthropogenic visibility impairment from mandatory class I areas. With the help of VISTAS, Virginia developed a SIP to address visibility impairment in the Commonwealth's two federal class I areas – the James River Face Wilderness Area and the Shenandoah National Park, both located in the mountains of Virginia (see Figure 2).

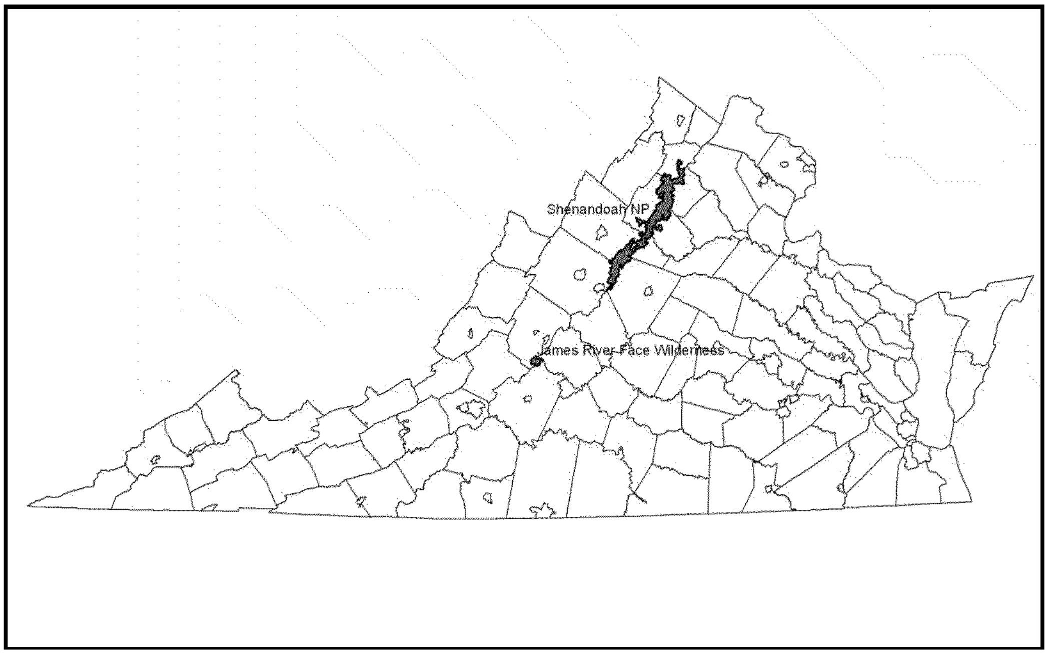

**Figure 2: Virginia Class I Areas**

In developing the Virginia Regional Haze SIP, which was given partial approval by EPA on June 13, 2012 (77 FR 35287), the Commonwealth prepared a long-term strategy and implemented Best Available Retrofit Technology (BART) in order to establish reasonable progress goals for the James River Face Wilderness Area and Shenandoah National Park. As provided in the SIP, for the 20% worst days, Virginia adopted the RPG of a 6.7 dv reduction in visibility impairment by 2018 for the James River Face Wilderness Area, which is consistent with the uniform rate of progress needed to achieve a natural background condition of 11.1 dv by 2064. Virginia has also adopted a reasonable progress goal for the 20% best days that would result in a 1.8 dv reduction in visibility impairment for the James River Face Wilderness Area. For Shenandoah National Park, Virginia adopted the RPG of 7.4 dv reduction in visibility impairment for the 20% worst days by 2018, which is consistent with the uniform rate of progress needed to achieve a natural background condition of 11.4 dv by 2064. For the 20% best days, Virginia adopted the RPG that would result in a 2.2 dv reduction in visibility impairment for Shenandoah National Park. The aforementioned predicted reductions in visibility impairment were expected to result from implementation of existing and planned emission controls that will be discussed in further detail.

In accordance with 40 CFR 51.308(g), Virginia's original SIP committed to submitting a report on reasonable progress to EPA every five years following the initial submittal of the SIP. This reasonable progress report addresses that requirement. It evaluates the progress made toward the RPG for Virginia's class I areas as well as for each mandatory class I area located outside of Virginia that may be significantly affected by emissions from Virginia sources.

## 1.2. Requirements for Periodic Progress Reports

The RHR, promulgated July 1, 1999 (64 FR 35714), established the following requirements for periodic reports describing the progress toward meeting the RPGs set forth in the Virginia Regional Haze SIP:

51.308(g) *Requirements for periodic reports describing progress towards the reasonable progress goals.* Each state identified in §51.300(b)(3) must submit a report to the Administrator every 5 years evaluating progress towards the reasonable progress goal for each mandatory Class I Federal area located within the State and in each mandatory Class I Federal area located outside the State which may be affected by emissions from within the State. The first progress report is due 5 years from submittal of the initial implementation plan addressing paragraphs (d) and (e) of this section. The progress reports must be in the form of implementation plan revisions that comply with the procedural requirements of §51.102 and §51.103. Periodic progress reports must contain at a minimum the following elements:

(1) A description of the status of implementation of all measures included in the implementation plan for achieving reasonable progress goals for mandatory Class I Federal areas both within and outside the state.

(2) A summary of the emission reductions achieved throughout the State through implementation of the measures described in paragraph (g)(1) of this section.

(3) For each mandatory Class I Federal area within the State, the State must assess the following visibility conditions and changes, with values for most impaired and least impaired days expressed in terms of 5-year averages of these annual values.

(i) The current visibility conditions for the most and least impaired days;
(ii) The difference between current visibility conditions for the most impaired and least impaired days and baseline visibility conditions;
(iii) The change in visibility impairment for the most impaired and least impaired days over the past 5 years.

(4) An analysis tracking the changes over the past 5 years in emissions of pollutants contributing to visibility impairment from all sources and activities within the State. Emissions changes should be identified by type of source or activity. The analysis must be based on the most recent updated emissions inventory, with estimates projected forward as necessary and appropriate, to account for emissions changes during the applicable 5-year period.

(5) An assessment of any significant changes in anthropogenic emissions within or outside the State that have occurred over the past 5 years that have limited or impeded progress in reducing pollutant emissions and improving visibility.

(6) An assessment of whether the current implementation plan elements and strategies are sufficient to enable the State, or other States with mandatory

Federal Class I areas affected by emissions from the State, to meet all established reasonable progress goals.

(7) A review of the State's visibility monitoring strategy and any modifications to the strategy as necessary.

### 1.3. Adequacy of the Existing SIP

The RHR also establishes the following requirements for determining the adequacy of the current Virginia Regional Haze SIP.

> 51.308(h) *Determination of the adequacy of existing implementation plan.* At the same time the State is required to submit any 5-year progress report to EPA in accordance with paragraph (g) of this section, the State must also take one of the following actions based upon the information presented in the progress report:
>
> (1) If the State determines that the existing implementation plan requires no further substantive revision at this time in order to achieve established goals for visibility improvement and emissions reductions, the State must provide to the Administrator a negative declaration that further revision of the existing implementation plan is not needed at this time.
>
> (2) If the State determines that the implementation plan is or may be inadequate to ensure reasonable progress due to emissions from sources in another State(s) which participated in a regional planning process, the State must provide notification to the Administrator and to the other State(s) which participated in the regional planning process with the States. The State must also collaborate with the other State(s) through the regional planning process for the purpose of developing additional strategies to address the plan's deficiencies.
>
> (3) Where the State determines that the implementation plan is or may be inadequate to ensure reasonable progress due to emissions from sources in another country, the State shall provide notification, along with available information, to the Administrator.
>
> (4) Where the State determines that the implementation plan is or may be inadequate to ensure reasonable progress due to emissions from sources within the State, the State shall revise its implementation plan to address the plan's deficiencies within one year.

## 2. Summary of the Virginia Regional Haze SIP

The RHR required states to establish RPGs, expressed in dv, for visibility improvement at each affected class I area, covering each (approximately) ten-year period until 2064. The first set of reasonable progress goals was required to be met through measures contained in the Commonwealth's long-term strategy covering the period from the baseline until 2018. This section discusses development of Virginia's long-term strategy, which was described in its Regional Haze SIP.

## 2.1. Relative Contributions to Visibility Impairment: Pollutants, Source Categories, and Geographic Areas

An important step toward identifying future reasonable progress measures was to identify the key pollutants contributing to visibility impairment at each class I area. To understand the relative benefit of further reducing emissions from different pollutants, source sectors, and geographic areas, VISTAS engaged the Georgia Institute of Technology to perform emission sensitivity model runs using CMAQ. Emissions sensitivities were initially performed for three episodes representing winter and summer conditions: Jan 2002, July 2001, and July 2002. These runs used the initial 2018 projection inventory and considered 30% reductions from specific pollutants, source categories, and geographic areas. Emissions sensitivities were repeated using the 2009 Base D projection inventory and two, month-long episodes from 2002: June 1 - July 10 and November 19 - December 19. Emissions in 2009 were reduced by 30% for each pollutant sensitivity run. This analysis evaluated the following pollutant contributions:

- $SO_2$ from electric generating unit (EGU) sources in each VISTAS state, other RPOs in the VISTAS 12-km grid, and boundary conditions from outside the 12-km domain.
- $SO_2$ from non-EGU point sources in each VISTAS state, other RPOs, and boundary conditions.
- $NO_X$ from ground level (on-road, non-road, and area) sources in each VISTAS state and other RPOs.
- $NO_X$ from point (EGU plus non-EGU) sources in each VISTAS state and other RPOs.
- Ammonia ($NH_3$) from all sources in VISTAS and other RPOs.
- Volatile organic compounds (VOC) from anthropogenic sources in the 12-km modeling domain.
- Primary carbon from all ground level sources in each VISTAS state and other RPOs.
- Primary carbon from all point sources in each VISTAS state and other RPOs.
- Primary carbon from all fires in each VISTAS state and other RPOs.

Results are shown in Figure 3 and Figure 4 for James River Face Wilderness Area and Shenandoah National Park, respectively, for the average of the 20% worst visibility days (see Table 1 for abbreviations used in this table). Responses for the 20% worst days were calculated by averaging the responses for the 20% worst days that were modeled in the two episodes.

As Figure 3 and Figure 4 illustrate, the greatest visibility benefits on the 20% worst days for James River Face Wilderness Area and Shenandoah National Park are projected to result from further reducing $SO_2$ emissions from EGUs. At both class I areas, benefits are projected from $SO_2$ reductions from EGUs in several VISTAS states, including Florida, Georgia, Kentucky, North Carolina, Tennessee, Virginia, and West Virginia. Contributions from other RPOs and $SO_2$ coming from outside the boundary are also significant. The greatest benefit would likely be from further EGU reductions in West Virginia, midwestern states, and from outside the boundary. Additional, smaller benefits would come from additional $SO_2$ emission reductions from non-utility, industrial point sources. Within the VISTAS states, the relative importance of $SO_2$ reductions from non-EGUs is similar to that for EGUs.

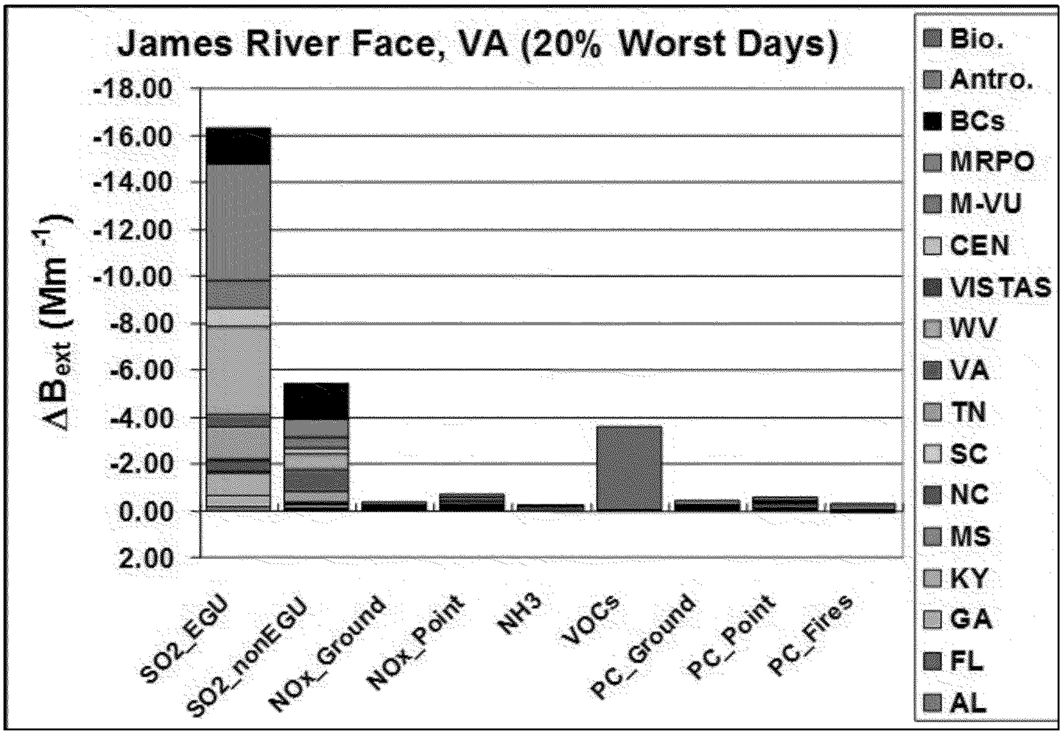


**Figure 3: Visibility Response-James River Face**

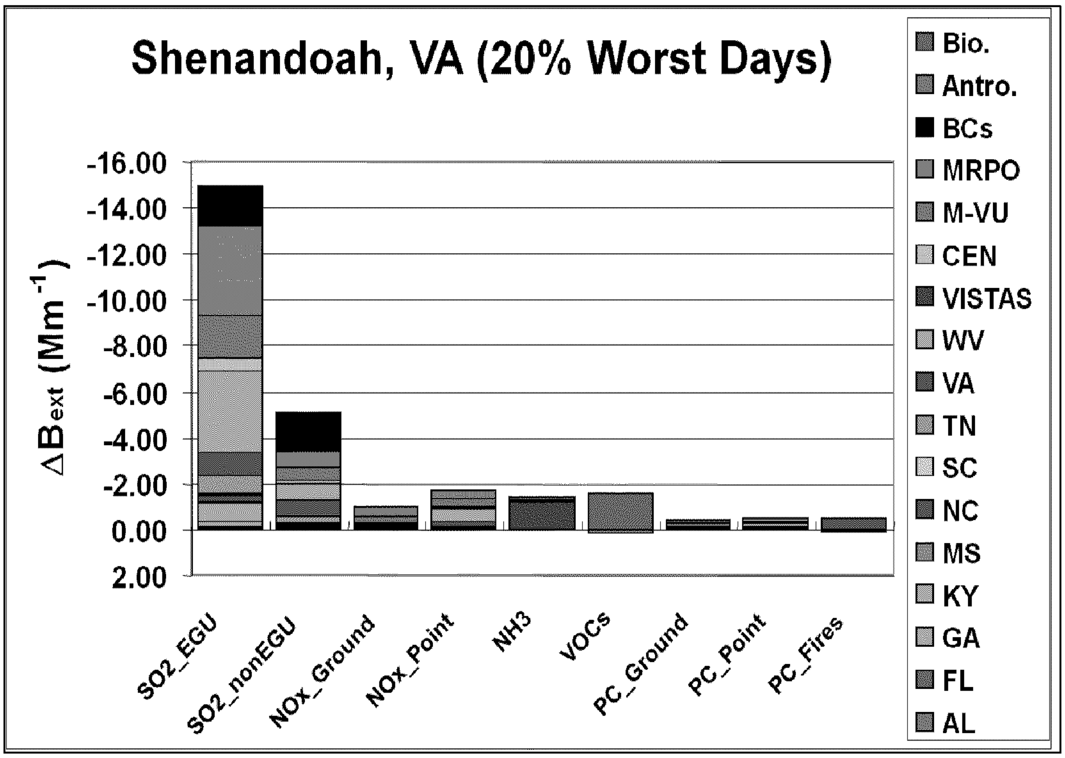


**Figure 4: Visibility Response-Shenandoah**

**Table 1: Visibility Modeling Response Table Abbreviations**

| | | | |
|---|---|---|---|
| BIO | Biogenic emissions | ANTRO | Anthropogenic emissions |
| BCs | Boundary condition emissions | MRPO | Midwest Regional Planning Organization emissions |
| M-VU | MANE-VU emissions | CEN | Central Regional Air Planning Association emissions |
| VISTAS | VISTAS emissions | WV | West Virginia emissions |
| VA | Virginia emissions | TN | Tennessee emissions |
| SC | South Carolina emissions | NC | North Carolina emissions |
| MS | Mississippi emissions | KY | Kentucky emissions |
| GA | Georgia emissions | FL | Florida emissions |
| AL | Alabama emissions | $SO_2$_EGU | $SO_2$ emissions from EGUs |
| $SO_2$_nonEGU | $SO_2$ emissions from non-EGUs | $NO_X$ _Ground | Ground level $NO_X$ emissions |
| $NO_X$_Point | $NO_X$ emissions from point sources | $NH_3$ | Ammonia emissions |
| VOCs | VOC emissions | PC_Ground | Ground level primary carbon emissions |
| PC_Point | Point source primary carbon emissions | PC_Fires | Primary carbon emissions from fires |

Ammonium nitrate is a small contributor to $PM_{2.5}$ mass and visibility impairment on the 20% worst days at both class I areas. Therefore, the benefits of reducing $NO_X$ and $NH_3$ are small.

VOC emissions in Virginia originate primarily from biogenic sources such as vegetative emissions, and also contribute to visibility impairment. Controlling anthropogenic sources of VOC has little, if any, visibility benefit at these class I areas. Reducing primary carbon from point sources, ground level sources, or fires is projected to have minimal visibility benefit. This is consistent with the monitoring data, which shows that most measured organic carbon is secondary in origin and that primary carbon is only a small fraction of the total measured carbon. Reducing carbon from fires was not found to be effective because there was little fire activity at these sites on the days modeled in the sensitivity analyses.

The results indicate that sulfate is the dominate contributor to visibility impairment on the 20% worst days at all VISTAS sites and that ammonium nitrate can be important for sites where 20% worst days occur in the winter. Virginia's Regional Haze SIP concluded that reducing $SO_2$ emissions from EGU and non-EGU point sources would have the greatest visibility benefit for its class I areas.

## 2.2. Relative Contributions to Visibility Impairment: Geographic Locations of the Largest Emissions Sources Contributing to Visibility Impairment at Virginia Class I Areas

After determining that $SO_2$ emission reductions from EGU and non-EGU point sources in the VISTAS states would be the most effective sources to control for visibility improvement at Virginia class I areas, the next step was to identify the specific geographic areas that most likely influence visibility in each class I area and then to identify the major $SO_2$ point sources located in those geographic areas. An $SO_2$ area of influence (AoI) was defined for each class I area to represent the geographic area containing sources that would likely have the greatest impact on visibility at that class I area. All $SO_2$ point sources within these AoIs were identified and ranked by their 2018 Base G emissions. The following contains a broad overview of the steps in the

AoI analyses. See Appendix H of the Virginia Regional Haze SIP for a more detailed discussion of these analyses and plots for additional class I areas.

The AoI analysis was not a source apportionment modeling exercise but rather a relative metric based on the magnitude of emissions from a source, its distance to the class I area(s) of concern, and the sulfate extinction weighted residence time plots, developed using back trajectories. In other words, the AoI analysis is not an exact quantification of source-by-source contribution to visibility impairment on the 20% worst days at a specific class I area. It is a relative metric used to infer this information.

### *2.2.1. Back Trajectory Analyses*

Meteorological back trajectories were generated for IMPROVE monitoring sites in Virginia and neighboring class I areas for the 2000-2004 baseline period. Back trajectory analyses use interpolated, measured, or modeled meteorological fields to estimate the most likely central path of air masses that arrive at a receptor at a given time. The method essentially follows a parcel of air backward in hourly steps for a specified length of time. Figure 5 is an example of a back trajectory analysis for Shenandoah National Park for the 20% worst days in 2002.

Trajectories were started at 100 meters and 500 meters above the surface and run backward from the site for 72 hours. These individual back trajectories for the 20% worst days in 2002 were also useful in evaluating model performance for individual days at the class I areas.

### *2.2.2. Residence Time Plots*

The residence time for each class I area was plotted using five years of back trajectories for the 20% worst visibility days in 2000-2004. Residence time is a measure of the frequency with which winds pass over a specific geographic area on the way to a class I area. Separate residence time plots were generated using trajectories with 100 meter and 500 meter start heights. As illustrated in Figure 6, winds influencing Shenandoah National Park on the 20% worst days come from all directions, with a significant southwest-northeast gradient influencing the 20% worst visibility days.

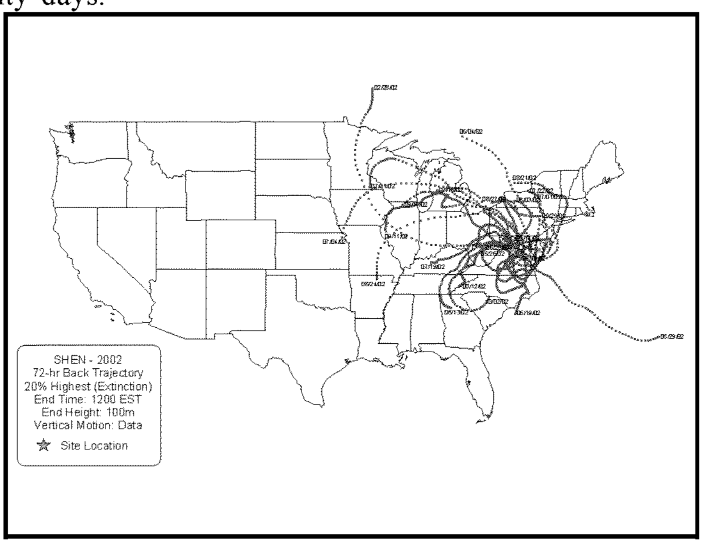


**Figure 5: Example Back-Trajectories for 2002 20% Worst Visibility Days, Shenandoah National Park**

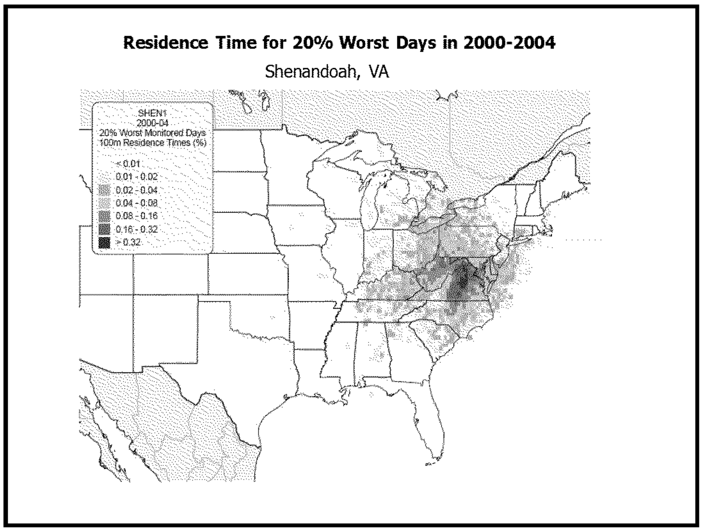


**Figure 6: Example Residence Time Plots for 2000-2004 20% Worst Days**

### *2.2.3. $SO_2$ Areas of Influence*

The next step in this process was to develop sulfate extinction-weighted residence time plots to define the geographic area with the highest probability of influencing the receptor on the 20% worst days in 2000-2004 that were dominated by sulfate. Each back trajectory was weighted by sulfate extinction for that day. This analysis allowed the focus to be on the 20% worst days that are influenced by sulfate and placed less importance on days influenced by organic carbon from fires. Sulfate-weighted back trajectories for 20% worst days were combined for 5 years of data. The resulting sulfate extinction-weighted residence time plots were used to define the geographic AoI for sources of $SO_2$ emissions. For example, in Figure 7 the area representing 10% or greater residence time is outlined in red and the area representing 5% or greater residence time is outlined in gray for the area surrounding Shenandoah National Park. The VISTAS states focused their analyses on the AoI defined by 5% or greater sulfate extinction-weighted residence time.

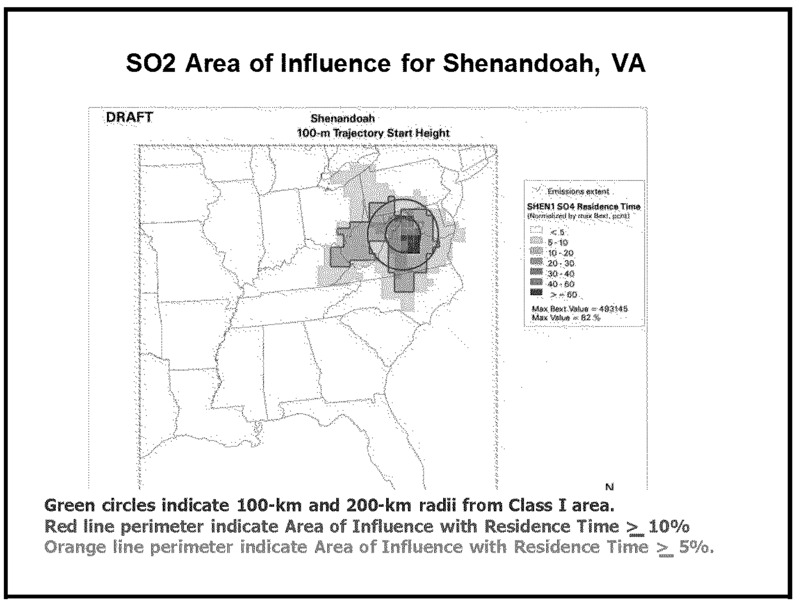


**Figure 7: Shenandoah $SO_2$ AoI**

### 2.2.4. *Emission Sources within $SO_2$ Areas of Influence*

Residence time plots were combined with geographically-gridded emissions data based on the 2002 baseline and 2018 Base G emissions inventories. Plots were generated for the AoIs defined by trajectories with 100 meter and 500 meter start heights. As a way of incorporating the effects of transport, deposition, and chemical transformation of point source emissions along the path of the trajectories, these data were weighted by 1/d, where d was calculated at the distance between grid cell centers, in kilometers. The distance-weighted point source $SO_2$ emissions were then combined with the gridded, extinction-weighted back-trajectory residence times at a spatial resolution of 36 kilometers.

The final step in this process was to combine the residence times and gridded emissions data in plots and data sets. The distance weighted (1/d), gridded point source $SO_2$ emissions were multiplied by the total extinction-weighted back-trajectory residence times on a grid cell by grid cell basis. These results were normalized by the domain-wide totals and displayed as a percentage. This analysis was done using both the 2002 and 2018 base year inventories. Figure 8 and Figure 9 illustrate 2002 and 2018 distance weighted, gridded emissions multiplied by sulfate-weighted residence time plots for the class I area. These maps, which were created for every VISTAS class I area as well as many class I areas in surrounding states, help visualize where emissions reductions will be occurring between 2002 and 2018. The change in $SO_2$ emissions between 2002 and 2018 can be seen by comparing emission source strengths in the two plots. Note that the emissions from each source are normalized by the total emissions in the domain. Sources that reduce $SO_2$ emissions by 2018 will show a lower contribution to emissions in the domain. On the 2018 map, the grid cells with these sources will show a lighter color gradient than on the 2002 map. For example, $SO_2$ reductions from EGUs in western Virginia and West Virginia resulting from the Clean Air Interstate Rule (CAIR) can be seen by comparing the 2002 and 2018 maps. The total emissions in the domain are smaller in 2018 so that a source that does not change emissions between 2002 and 2018 may actually appear to increase in importance in 2018 compared to 2002.

The 2018 plots in Figure 8 and Figure 9 also illustrate the relative importance of Virginia sources compared to sources in neighboring states. Appendix H of the Virginia Regional Haze SIP contained additional analyses, including 2002 and 2018 distance-weighted emissions multiplied by residence time plots for the class I areas in neighboring states.

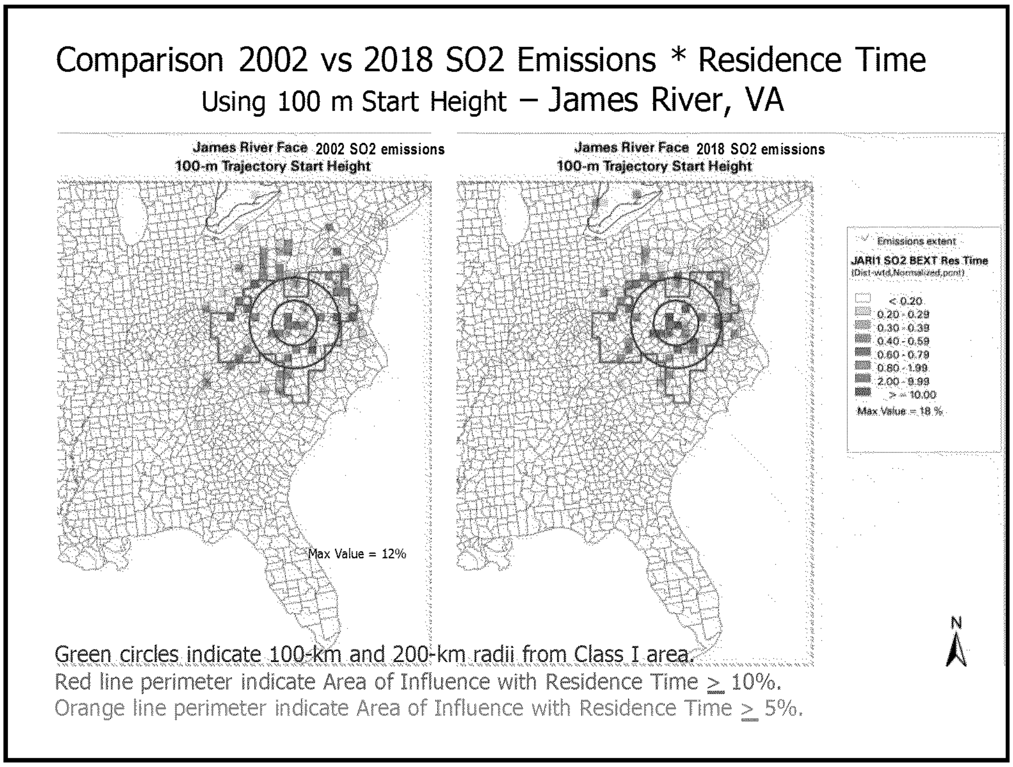


**Figure 8: James River Face 2002 and 2018 Plots**

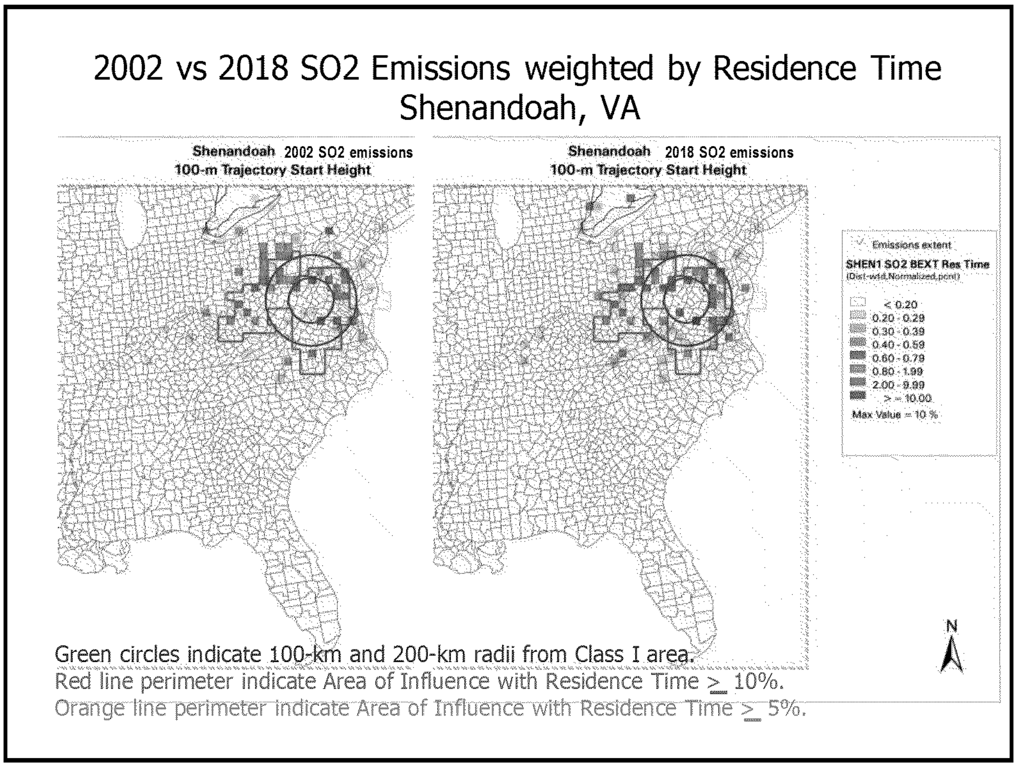


**Figure 9: Shenandoah 2002 and 2018 Plots**

Finally, Table 2 and Table 3 show the relative contributions of point source $SO_2$ emissions from nearby states to the Virginia class I areas and the North Caroline class I areas (Linville Gorge, Swanquarter, Joyce Kilmer, Shining Rock, and Great Smoky Mountains). Table 4 provides this data for other class I areas in nearby states (Dolly Sods in West Virginia, Brigantine in New Jersey, and Mammoth Cave in Kentucky). The AoI analysis is not a source apportionment modeling exercise, but rather a relative metric based on the magnitude of emissions from a source, its distance to the class I areas of concern, and the sulfate extinction-weighted residence time plots developed using back trajectories. In other words, it is not an exact quantification of source-by-source contribution to visibility impairment on the 20% worst days at a specific class I area but is a relative metric used to infer this information.

**Table 2: State 2018 $SO_2$ Point Source Contributions to Virginia Class I Areas**

| State | Virginia Class I Areas | |
|---|---|---|
| | Shenandoah | James River Face |
| Washington DC | 0.06% | 0.36% |
| Delaware | 1.46% | 0.59% |
| Kentucky | 1.10% | 2.02% |
| Maryland | 23.99% | 3.12% |
| New York | 0.19% | --- |
| North Carolina | 3.97% | 9.31% |
| Ohio | 4.63% | 3.60% |
| Pennsylvania | 6.11% | 1.59% |
| South Carolina | --- | 0.89% |
| Tennessee | 0.36% | 1.69% |
| Virginia | 38.33% | 62.08% |
| West Virginia | 19.85% | 15.10% |

**Table 3: State 2018 $SO_2$ Point Source Contributions to North Carolina Class I Areas**

| State | North Carolina Class I Areas | | | | |
|---|---|---|---|---|---|
| | Great Smoky Mountains | Shining Rock | Linville Gorge | Swanquarter | Joyce Kilmer |
| Alabama | 3.1% | 1.84% | 1.35% | ---- | 6.53% |
| Delaware | --- | --- | --- | 2.83% | --- |
| Florida | --- | --- | --- | 2.35% | --- |
| Georgia | 7.7% | 7.22% | 1.98% | 3.34% | 20.46% |
| Kentucky | 1.0% | 0.81% | 0.90% | 0.10% | 1.38% |
| Maryland | --- | --- | --- | 1.34% | --- |
| New Jersey | --- | --- | --- | 1.10% | --- |
| North Carolina | 7.4% | 58.84% | 34.75% | 58.69% | 9.08% |
| Ohio | 0.9% | 0.64% | 1.76% | --- | --- |
| Pennsylvania | --- | --- | --- | 0.50% | --- |
| South Carolina | 2.4% | 14.89% | 3.93% | 15.35% | 5.14% |
| Tennessee | 74.5% | 12.19% | 36.28% | --- | 55.87% |
| Virginia | 2.3% | 2.95% | 16.52% | 13.78% | 1.53% |
| West Virginia | 0.5% | 0.63% | 2.52% | 0.63% | --- |

**Table 4: State 2018 $SO_2$ Point Source Contributions to Other Class I Areas**

| State | Class I Areas | | |
|---|---|---|---|
| | Dolly Sods, WV | Brigantine, NJ | Mammoth Cave, KY |
| Washington DC | --- | 0.05% | --- |
| Alabama | --- | --- | 4.33% |
| Connecticut | --- | 0.05% | --- |
| Delaware | --- | 27.83% | --- |
| Georgia | --- | --- | 1.79% |
| Illinois | --- | --- | 0.53% |
| Indiana | --- | --- | 21.22% |
| Kentucky | 1.34% | --- | 53.60% |
| Maryland | 11.81% | 7.67% | --- |
| Mississippi | --- | --- | 0.04% |
| Missouri | --- | --- | 0.53% |
| New Jersey | --- | 40.11% | --- |
| New York | --- | 0.56% | --- |
| North Carolina | 0.80% | 0.75% | --- |
| Ohio | 7.37% | 0.52% | 3.95% |
| Pennsylvania | 5.26% | 13.63% | --- |
| South Carolina | 0.09% | --- | --- |
| Tennessee | 1.25% | --- | 13.46% |
| Virginia | 5.73% | 7.90% | --- |
| West Virginia | 66.35% | 0.94% | 0.54% |

This analysis resulted in 337 stacks identified within the AoI that were projected to contribute to sulfate at James River Face Wilderness Area, including 86 stacks in Virginia. Thirty-seven stacks were projected to have a relative contribution greater than or equal to 0.5% and contributed 67.16% to sulfate, including 20 stacks in Virginia, 8 of which are associated with EGUs. Table 5 identifies the stacks within the AoI for James River Face Wilderness Area that are projected to contribute at least 0.5% to the total calculated sulfate impairment.

For Shenandoah National Park, this analysis resulted in 300 stacks identified within the AoI that were projected to contribute to sulfate, including 73 stacks in Virginia. Thirty-nine stacks were projected to have a relative contribution greater than or equal to 0.5% and contributed 57.62% to sulfate, including 13 stacks in Virginia, 6 of which are associated with EGUs. Table 6 identifies the stacks within the AoI for Shenandoah National Park that are projected to contribute at least 0.5% to the total calculated sulfate impairment.

## Table 5: James River Face Point Source Sulfate Contribution Analysis

| Source Identification | | | | | | 2002 | 2018 Base Case | | AOI & Associated Metrics | | | Contribution Analysis | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| State | FIPS County | Plant ID | Plant Name | Point ID | SIC | $SO_2$ Emissions (tpy) | $SO_2$ Emissions (tpy) | CE (%) | Distance (km) | Q/d | RT Max | Q/d* RT Max | Contr'n (%) | State Contr'n (%) |
| VA | 580 | 00003 | MEADWESTVACO PACKAGING RESOURCE GROUP | 25 | 2611 | 8,552 | 9,997 | 0 | 46 | 215 | 76 | 16,358 | 18.49% | 67.16% |
| VA | 023 | 00003 | ROANOKE CEMENT COMPANY | 22 | 3241 | 2,885 | 3,976 | 0 | 46 | 86 | 76 | 6,508 | 7.35% | 67.16% |
| VA | 019 | 00003 | GEORGIA PACIFIC CORP BIG ISLAND PLT | 1 | 2631 | 1,090 | 1,223 | 4 | 17 | 72 | 68 | 4,846 | 5.48% | 67.16% |
| VA | 163 | 00001 | MOHAWK INDUSTRIES INC - LEES CARPETS DIV | 7 | 2273 | 293 | 290 | 4 | 6 | 47 | 76 | 3,549 | 4.01% | 67.16% |
| VA | 071 | 00002 | AMERICAN ELECTRIC POWER GLEN LYN | 3 | 4911 | 7,488 | 9,981 | 0 | 123 | 81 | 40 | 3,219 | 3.64% | 67.16% |
| VA | 071 | 00004 | CELANESE ACETATE LLC | 1 | 2823 | 6,559 | 6,509 | 4 | 115 | 57 | 40 | 2,243 | 2.54% | 67.16% |
| VA | 065 | 00001 | DOMINION - BREMO POWER STATION | 2 | 4911 | 7,993 | 6,253 | 0 | 108 | 58 | 34 | 1,989 | 2.25% | 67.16% |
| WV | 079 | 0006 | APPALACHIAN POWER - JOHN E AMOS PLANT | 003 | 4911 | 39,570 | 10,821 | 95 | 223 | 48 | 33 | 1,584 | 1.79% | 14.42% |
| VA | 019 | 00003 | GEORGIA PACIFIC CORP BIG ISLAND PLT | 2 | 2631 | 251 | 286 | 0 | 17 | 17 | 68 | 1,131 | 1.28% | 67.16% |
| NC | 157 | 37-157-00015 | DUKE ENERGY CORP - DAN RIVER STEAM STATI | G-21 | 4911 | 2,637 | 3,464 | 0 | 128 | 27 | 39 | 1,056 | 1.19% | 9.55% |
| WV | 079 | 0006 | APPALACHIAN POWER - JOHN E AMOS PLANT | 002 | 4911 | 27,651 | 6,694 | 95 | 223 | 30 | 33 | 980 | 1.11% | 14.42% |
| WV | 079 | 0006 | APPALACHIAN POWER - JOHN E AMOS PLANT | 001 | 4911 | 30,015 | 6,613 | 95 | 223 | 30 | 33 | 968 | 1.09% | 14.42% |
| TN | 163 | 0003 | EASTMAN CHEMICAL COMPANY | 021520 | 2869 | 16,855 | 16,729 | 4 | 295 | 57 | 15 | 870 | 0.98% | 2.03% |
| WV | 053 | 0009 | APPALACHIAN POWER - MOUNTAINEER PLANT | 001 | 4911 | 39,064 | 11,433 | 95 | 260 | 44 | 20 | 865 | 0.98% | 14.42% |
| VA | 065 | 00001 | DOMINION - BREMO POWER STATION | 1 | 4911 | 4,371 | 2,614 | 0 | 108 | 24 | 34 | 831 | 0.94% | 67.16% |
| NC | 169 | 37-169-00004 | DUKE ENERGY CORP - BELEWS CREEK STEAM ST | G-18 | 4911 | 43,789 | 3,218 | 90 | 157 | 20 | 39 | 800 | 0.90% | 9.55% |
| VA | 167 | 00003 | AMERICAN ELECTRIC POWER-CLINCH RIVER PLA | 2 | 4911 | 8,115 | 10,131 | 0 | 250 | 41 | 17 | 692 | 0.78% | 67.16% |
| VA | 167 | 00003 | AMERICAN ELECTRIC POWER-CLINCH RIVER PLA | 1 | 4911 | 8,158 | 10,014 | 0 | 250 | 40 | 17 | 684 | 0.77% | 67.16% |
| VA | 167 | 00003 | AMERICAN ELECTRIC POWER-CLINCH RIVER PLA | 3 | 4911 | 8,804 | 9,911 | 0 | 250 | 40 | 17 | 677 | 0.76% | 67.16% |
| NC | 169 | 37-169-00004 | DUKE ENERGY CORP - BELEWS CREEK STEAM ST | G-17 | 4911 | 39,678 | 2,536 | 90 | 157 | 16 | 39 | 630 | 0.71% | 9.55% |
| VA | 121 | 00006 | ALLIANT AMMUNITION & POWDER COMPANY LLC | 3 | 2892 | 1,102 | 1,593 | 0 | 104 | 15 | 40 | 608 | 0.69% | 67.16% |
| VA | 580 | 00003 | MEADWESTVACO PACKAGING RESOURCE GROUP | 8 | 2611 | 301 | 352 | 0 | 46 | 8 | 76 | 576 | 0.65% | 67.16% |
| NC | 157 | 37-157-00015 | DUKE ENERGY CORP - DAN RIVER STEAM STATI | G-23 | 4911 | 1,040 | 1,837 | 0 | 128 | 14 | 39 | 560 | 0.63% | 9.55% |

| Source Identification | | | | | | 2002 | 2018 Base Case | | AOI & Associated Metrics | | | Contribution Analysis | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| State | FIPS County | Plant ID | Plant Name | Point ID | SIC | $SO_2$ Emissions (tpy) | $SO_2$ Emissions (tpy) | CE (%) | Distance (km) | Q/d | RT Max | Q/d* RT Max | Contr'n (%) | State Contr'n (%) |
| WV | 033 | 0015 | MONONGAHELA POWER CO-HARRISON | 003 | 4911 | 2,582 | 5,998 | 95 | 208 | 29 | 19 | 558 | 0.63% | 14.42% |
| VA | 071 | 00002 | AMERICAN ELECTRIC POWER GLEN LYN | 1 | 4911 | 1,827 | 1,721 | 0 | 123 | 14 | 40 | 555 | 0.63% | 67.16% |
| VA | 071 | 00002 | AMERICAN ELECTRIC POWER GLEN LYN | 2 | 4911 | 1,738 | 1,721 | 0 | 123 | 14 | 40 | 555 | 0.63% | 67.16% |
| WV | 033 | 0015 | MONONGAHELA POWER CO-HARRISON | 002 | 4911 | 2,731 | 5,954 | 95 | 208 | 29 | 19 | 554 | 0.63% | 14.42% |
| WV | 033 | 0015 | MONONGAHELA POWER CO-HARRISON | 001 | 4911 | 3,355 | 5,908 | 95 | 208 | 28 | 19 | 550 | 0.62% | 14.42% |
| VA | 027 | 00004 | JEWEL COKE COMPANY LLP | 24 | 3312 | 3,998 | 4,526 | 0 | 227 | 20 | 27 | 542 | 0.61% | 67.16% |
| VA | 031 | 00156 | DOMINION - ALTAVISTA POWER STATION | 1 | 4911 | 50 | 778 | 0 | 60 | 13 | 41 | 528 | 0.60% | 67.16% |
| VA | 121 | 00006 | ALLIANT AMMUNITION & POWDER COMPANY LLC | 4 | 2892 | 911 | 1,317 | 0 | 104 | 13 | 40 | 503 | 0.57% | 67.16% |
| KY | 127 | 21-127-00003 | KENTUCKY POWER CO BIG SANDY PLANT | 002 | 4911 | 36,036 | 4,203 | 90 | 279 | 15 | 33 | 490 | 0.55% | 2.03% |
| NC | 145 | 37-145-00029 | CP&L - ROXBORO STEAM ELECTRIC PLANT | G-30 | 4911 | 29,504 | 2,438 | 90 | 133 | 18 | 27 | 486 | 0.55% | 9.55% |
| VA | 121 | 00006 | ALLIANT AMMUNITION & POWDER COMPANY LLC | 5 | 2892 | 873 | 1,262 | 0 | 104 | 12 | 40 | 482 | 0.54% | 67.16% |
| KY | 019 | 21-019-00004 | MARATHON ASHLAND PET LLC | 064 | 2911 | 3,977 | 5,155 | 0 | 283 | 18 | 26 | 473 | 0.53% | 2.03% |
| WV | 019 | 0001 | ELKEM METALS COMPANY - ALLOY L.P. | 006 | 3313 | 1,937 | 1,922 | 4 | 165 | 12 | 41 | 472 | 0.53% | 14.42% |
| NC | 157 | 37-157-00015 | DUKE ENERGY CORP - DAN RIVER STEAM STATI | G-22 | 4911 | 938 | 1,498 | 0 | 128 | 12 | 39 | 457 | 0.52% | 9.55% |
| | | | | | | | | TOTAL: All Sources | | | | 88,486 | 100% | 337 units |
| | | | | | | | | Contribution from 0.5% units: | | | | 59,426 | 67.16% | 37 units |
| | | | | | | | | Contribution from 1.0% units: | | | | 44,431 | 50.21% | 12 units |

## Table 6: Shenandoah Point Source Sulfate Contribution Analysis

| Source Identification | | | | | | 2002 | 2018 Base Case | | AOI & Associated Metrics | | | Contribution Analysis | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| State | FIPS County | Plant ID | Plant Name | Point ID | SIC | $SO_2$ Emissions (tpy) | $SO_2$ Emissions (tpy) | CE (%) | Distance (km) | Q/d | RT Max | Q/d* RT Max | Contr'n (%) | State Contr'n (%) |
| VA | 065 | 00001 | DOMINION - BREMO POWER STATION | 2 | 4911 | 7,993 | 6,253 | 0 | 92 | 68 | 82 | 5,597 | 8.92% | 38.59% |
| VA | 153 | 00002 | DOMINION - POSSUM POINT | 5 | 4911 | 4,368 | 6,100 | 0 | 100 | 61 | 51 | 3,077 | 4.91% | 38.59% |
| MD | 001 | 001-0011 | MARYLAND DEPARTMENT OF THE ENVIRONMENT | 1 | 2621 | 10,160 | 9,610 | 0 | 119 | 81 | 32 | 2,596 | 4.14% | 24.16% |
| VA | 065 | 00001 | DOMINION - BREMO POWER STATION | 1 | 4911 | 4,371 | 2,614 | 0 | 92 | 29 | 82 | 2,340 | 3.73% | 38.59% |
| MD | 001 | 001-0011 | MARYLAND DEPARTMENT OF THE ENVIRONMENT | 2 | 2621 | 8,923 | 8,441 | 0 | 119 | 71 | 32 | 2,281 | 3.64% | 24.16% |
| VA | 041 | 00002 | DOMINION - CHESTERFIELD POWER STATION | 8 | 4911 | 38,088 | 3,633 | 95 | 157 | 23 | 66 | 1,516 | 2.42% | 38.59% |
| MD | 021 | 021-0005 | MARYLAND DEPARTMENT OF THE ENVIRONMENT | 28 | 3334 | 1,506 | 2,652 | 0 | 123 | 22 | 51 | 1,089 | 1.74% | 24.16% |
| MD | 021 | 021-0005 | MARYLAND DEPARTMENT OF THE ENVIRONMENT | 29 | 3334 | 1,506 | 2,652 | 0 | 123 | 22 | 51 | 1,089 | 1.74% | 24.16% |
| MD | 043 | 043-0005 | ALLEGANY ENERGY SUPPLY LLC - R. PAUL SMI | 2 | 4911 | 3,770 | 2,568 | 0 | 132 | 19 | 51 | 984 | 1.57% | 24.16% |
| MD | 017 | 017-0014 | MIRANT MID-ATLANTIC LLC | 14 | 4911 | 37,757 | 3,037 | 90 | 128 | 24 | 39 | 926 | 1.48% | 24.16% |
| MD | 017 | 017-0014 | MIRANT MID-ATLANTIC LLC | 15 | 4911 | 32,587 | 2,987 | 90 | 128 | 23 | 39 | 911 | 1.45% | 24.16% |
| WV | 003 | 0006 | CAPITOL CEMENT CORPORATION | 010 | 3241 | 1,247 | 1,717 | 0 | 109 | 16 | 51 | 802 | 1.28% | 19.03% |
| WV | 023 | 0003 | MOUNT STORM POWER PLANT | 001 | 4911 | 8,817 | 3,191 | 95 | 104 | 31 | 24 | 743 | 1.18% | 19.03% |
| WV | 023 | 0003 | MOUNT STORM POWER PLANT | 002 | 4911 | 9,572 | 3,191 | 95 | 104 | 31 | 24 | 743 | 1.18% | 19.03% |
| WV | 023 | 0003 | MOUNT STORM POWER PLANT | 003 | 4911 | 2,779 | 2,923 | 94.98 | 104 | 28 | 24 | 681 | 1.08% | 19.03% |
| WV | 033 | 0015 | MONONGAHELA POWER CO-HARRISON | 003 | 4911 | 2,582 | 5,998 | 95 | 189 | 32 | 21 | 654 | 1.04% | 19.03% |
| VA | 041 | 00002 | DOMINION - CHESTERFIELD POWER STATION | 6 | 4911 | 19,129 | 1,561 | 95 | 157 | 10 | 66 | 651 | 1.04% | 38.59% |
| WV | 033 | 0015 | MONONGAHELA POWER CO-HARRISON | 002 | 4911 | 2,731 | 5,954 | 95 | 189 | 32 | 21 | 649 | 1.03% | 19.03% |
| WV | 033 | 0015 | MONONGAHELA POWER CO-HARRISON | 001 | 4911 | 3,355 | 5,908 | 95 | 189 | 31 | 21 | 644 | 1.03% | 19.03% |
| MD | 021 | 021-0003 | MARYLAND DEPARTMENT OF THE ENVIRONMENT | 16 | 3295 | 1,321 | 1,658 | 99 | 147 | 11 | 51 | 568 | 0.91% | 24.16% |
| DE | 005 | 10005 00001 | INDIAN RIVER GENERATING STATION | 004 | 4911 | 7,504 | 19,666 | 0 | 279 | 71 | 8 | 555 | 0.89% | 1.47% |
| WV | 053 | 0009 | APPALACHIAN POWER - MOUNTAINEER PLANT | 001 | 4911 | 39,064 | 11,433 | 95 | 308 | 37 | 14 | 505 | 0.81% | 19.03% |
| WV | 079 | 0006 | APPALACHIAN POWER - JOHN E AMOS PLANT | 003 | 4911 | 39,570 | 10,821 | 95 | 295 | 37 | 14 | 499 | 0.80% | 19.03% |

| Source Identification | | | | | | 2002 | 2018 Base Case | | AOI & Associated Metrics | | | Contribution Analysis | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| State | FIPS County | Plant ID | Plant Name | Point ID | SIC | $SO_2$ Emissions (tpy) | $SO_2$ Emissions (tpy) | CE (%) | Distance (km) | Q/d | RT Max | Q/d* RT Max | Contr'n (%) | State Contr'n (%) |
| VA | 041 | 00078 | DUPONT DE NEMOURS E I & COMPANY INC JAME | 2 | 2819 | 1,145 | 1,117 | 0 | 152 | 7 | 66 | 480 | 0.77% | 38.59% |
| VA | 580 | 00003 | MEADWESTVACO PACKAGING RESOURCE GROUP | 25 | 2611 | 8,552 | 9,997 | 0 | 159 | 63 | 7 | 456 | 0.73% | 38.59% |
| VA | 023 | 00003 | ROANOKE CEMENT COMPANY | 22 | 3241 | 2,885 | 3,976 | 0 | 181 | 22 | 20 | 433 | 0.69% | 38.59% |
| VA | 041 | 00081 | PHILIP MORRIS USA INC - PARK 500 | 3 | 2141 | 1,070 | 1,062 | 4 | 166 | 6 | 66 | 420 | 0.67% | 38.59% |
| MD | 021 | 021-0003 | MARYLAND DEPARTMENT OF THE ENVIRONMENT | 17 | 3295 | 976 | 1,225 | 99 | 147 | 8 | 51 | 420 | 0.67% | 24.16% |
| VA | 099 | ORIS 54304 | SEI BIRCHWOOD POWER FACILITY | 1 | 4911 | 0 | 2,789 | 0 | 102 | 27 | 15 | 417 | 0.66% | 38.59% |
| VA | 101 | 00001 | STONE CONTAINER CORP (D/B/A SMURFIT-STON | 2 | 2611 | 3,562 | 4,006 | 4 | 180 | 22 | 18 | 402 | 0.64% | 38.59% |
| WV | 061 | 0001 | MONONGAHELA POWER CO.- FORT MARTIN POWER | 001 | 4911 | 46,852 | 4,922 | 95 | 183 | 27 | 14 | 375 | 0.60% | 19.03% |
| WV | 061 | 0001 | MONONGAHELA POWER CO.- FORT MARTIN POWER | 002 | 4911 | 42,467 | 4,890 | 95 | 183 | 27 | 14 | 373 | 0.59% | 19.03% |
| VA | 085 | 00042 | BEAR ISLAND PAPER COMPANY LLC | 1 | 2621 | 470 | 528 | 4 | 117 | 4 | 77 | 347 | 0.55% | 38.59% |
| MD | 021 | 021-0013 | MARYLAND DEPARTMENT OF THE ENVIRONMENT | 21 | 3241 | 574 | 811 | 99 | 127 | 6 | 51 | 324 | 0.52% | 24.16% |
| VA | 041 | 00081 | PHILIP MORRIS USA INC - PARK 500 | 2 | 2141 | 823 | 817 | 4 | 166 | 5 | 66 | 323 | 0.52% | 38.59% |
| MD | 043 | 043-0005 | ALLEGANY ENERGY SUPPLY LLC - R. PAUL SMI | 1 | 4911 | 820 | 836 | 0 | 132 | 6 | 51 | 320 | 0.51% | 24.16% |
| MD | 021 | 021-0013 | MARYLAND DEPARTMENT OF THE ENVIRONMENT | 22 | 3241 | 564 | 797 | 99 | 127 | 6 | 51 | 318 | 0.51% | 24.16% |
| MD | 003 | 003-0468 | CONSTELLATION POWER SOURCE GENERATION - | 1 | 4911 | 20,476 | 3,800 | 90 | 180 | 21 | 15 | 315 | 0.50% | 24.16% |
| MD | 005 | 005-0147 | MARLYAND DEPARTMENT OF THE ENVIRONMENT | 31 | 3312 | 2,841 | 3,919 | 99 | 186 | 21 | 15 | 315 | 0.50% | 24.16% |
| | | | | | | | | TOTAL: All Sources | | | | 62,722 | 100% | 300 stacks |
| | | | | | | | | Contribution from 0.5% units: | | | | 36,138 | 57.62% | 39 stacks |
| | | | | | | | | Contribution from 1.0% units: | | | | 27,972 | 44.60% | 19 stacks |

### 2.2.5. *Specific Source Types in the AoI*

Reviewing emissions inventories to determine the source categories, as well as specific sources, found to have the greatest impact on visibility in Virginia was the next step in this process. Lists of $SO_2$ point sources found within the AoI for each class I area were developed using the most current (Base G) VISTAS 2002 base year and 2018 future year emissions. For this purpose the AoI was defined as the counties with maximum sulfate extinction-weighted residence time greater than 5%. For $SO_2$ sources within each AoI, the following attributes were defined for each individual unit:

- State, county, source (plant), and industry identification codes.
- $SO_2$ emissions for 2002 and 2018.
- 2018 control efficiency.
- Distance to class I areas (defined by the centroid of the class I area).
- Emissions divided by distance (Q/d), a metric that accounts for dispersion of emissions over distance.
- Maximum sulfate extinction-weighted residence time (Rtmax).

The review was conducted in a top-down fashion starting with an analysis of the major source categories in each $SO_2$ AoI to determine which major categories had the highest residual contribution to the area in 2018. Identification of reductions projected to occur between 2002 and 2018 was an important part of this process. Analysis of this information allowed VISTAS states to determine if certain source categories or units that had yet to be controlled under the future year base case had the potential for reduction. Once the highest emitting source types were identified, subcategories within those sources types were reviewed. The contributions from major source categories to the 2018 Base G2 inventory for the $SO_2$ AoI for James River Face Wilderness Area and Shenandoah National Park are listed in Table 7 and Table 8.

**Table 7: 2018 Emissions Contributions from Source Categories, James River Face**

| Tier | VOC | $NO_X$ | CO | $SO_2$ | $PM_{10}$-Pri | $PM_{2.5}$-Pri | $NH_3$ |
|---|---|---|---|---|---|---|---|
| Fuel Combustion Electric Utilities | 1% | 26% | 1% | 53% | 15% | 27% | 1% |
| Fuel Combustion Industrial | 1% | 17% | 2% | 28% | 4% | 6% | 0% |
| Fuel Combustion Other | 7% | 8% | 4% | 6% | 7% | 14% | 1% |
| Chem & Allied Product Mfg | 2% | 1% | 1% | 2% | 1% | 1% | 1% |
| Metals Processing | 1% | 2% | 4% | 4% | 3% | 5% | 0% |
| Petroleum & Related Industries | 0% | 0% | 0% | 2% | 0% | 0% | 0% |
| Other Industrial Processes | 4% | 5% | 0% | 4% | 9% | 11% | 1% |
| Solvent Utilization | 39% | 1% | 0% | 0% | 0% | 1% | 0% |
| Storage & Transport | 7% | 0% | 0% | 0% | 0% | 1% | 0% |
| Waste Disposal & Recycling | 4% | 2% | 4% | 0% | 5% | 9% | 0% |
| Highway Vehicles | 19% | 21% | 47% | 0% | 2% | 2% | 11% |
| Off-Highway | 14% | 17% | 36% | 1% | 3% | 5% | 0% |
| Miscellaneous | 1% | 0% | 2% | 0% | 50% | 18% | 85% |

**Table 8: 2018 Emissions Contributions from Source Categories, Shenandoah National Park**

| Tier | VOC | $NO_X$ | CO | $SO_2$ | $PM_{10}$-Pri | $PM_{2.5}$-Pri | $NH_3$ |
|---|---|---|---|---|---|---|---|
| Fuel Combustion Electric Utilities | 1% | 26% | 1% | 53% | 14% | 25% | 1% |
| Fuel Combustion Industrial | 1% | 17% | 2% | 28% | 5% | 6% | 0% |
| Fuel Combustion Other | 7% | 9% | 4% | 6% | 7% | 14% | 1% |
| Chem & Allied Product Mfg | 2% | 1% | 1% | 2% | 1% | 1% | 1% |
| Metals Processing | 1% | 2% | 4% | 4% | 3% | 6% | 0% |
| Petroleum & Related Industries | 1% | 0% | 0% | 2% | 0% | 0% | 0% |
| Other Industrial Processes | 3% | 6% | 0% | 5% | 9% | 10% | 1% |
| Solvent Utilization | 39% | 1% | 0% | 0% | 0% | 1% | 0% |
| Storage & Transport | 6% | 0% | 1% | 0% | 1% | 1% | 0% |
| Waste Disposal & Recycling | 4% | 2% | 3% | 0% | 4% | 9% | 0% |
| Highway Vehicles | 19% | 20% | 45% | 0% | 2% | 2% | 20% |
| Off-Highway | 16% | 18% | 37% | 1% | 3% | 7% | 0% |
| Miscellaneous | 0% | 0% | 1% | 0% | 50% | 18% | 85% |

These tables indicate that for Virginia's class I areas, electric utilities and industrial boilers are the two major source categories contributing to 2018 $SO_2$ emissions, even after implementation of CAIR. Together these two source categories contribute 81% of the 2018 $SO_2$ emissions to the AoI for each class I area.

These tables can also be used to evaluate the major source categories contributing to emissions of $NO_X$, $NH_3$, and particulate matter (PM) emissions in 2018. For instance, highway vehicles and off-road vehicles are major sources of $NO_x$ emissions, in addition to electric utilities and industrial boilers. The source category "miscellaneous," which includes agricultural sources and fires, is the major contributor to $NH_3$ and primary PM.

The contributions to $SO_2$ emissions in 2018 from the three highest source categories, electric utilities, industrial boilers, and other fuel combustion, have been further broken out into subcategories (see Table 9). Within electric utilities, nearly all the $SO_2$ emissions are attributable to coal-fired power plants. Within industrial boilers, most emissions are attributable to coal-fired boilers with lesser contributions from oil and gas boilers. Commercial and institutional coal- and oil-fired boilers have smaller contributions.

**Table 9: Annual 2018 $SO_2$ Emissions Percentages within AoIs**

| Tier | Shenandoah | James River Face |
|---|---|---|
| Fuel Combustion Electrical Utility – Coal | 51% | 51% |
| Fuel Combustion Electric Utility-Oil | 1% | 1% |
| Fuel Combustion Electric Utility-Gas | 0% | 0% |
| Fuel Combustion Electric Utility-Other | 0% | 0% |
| Fuel Combustion Electric Utility-IC | 1% | 1% |
| Fuel Combustion Industrial-Coal | 22% | 23% |
| Fuel Combustion Industrial-Oil | 3% | 3% |

| Tier | Shenandoah | James River Face |
|---|---|---|
| Fuel Combustion Industrial-Gas | 2% | 2% |
| Fuel Combustion Industrial-Other | 1% | 1% |
| Fuel Combustion Industrial-IC | 0% | 0% |
| Fuel Combustion Other-Commercial Institutional Coal | 2% | 2% |
| Fuel Combustion Other-Commercial/Institutional Oil | 1% | 1% |
| Fuel Combustion Other-Commercial/Institutional Gas | 0% | 0% |
| Fuel Combustion Other-Misc Fuel Combustion except Residential | 0% | 0% |
| Fuel Combustion Other-Residential Wood | 0% | 0% |
| Fuel Combustion Other-Residential Other | 2% | 2% |

These analyses indicated that Virginia should consider what additional control measures for electric utilities and industrial boilers were reasonable. The lists of individual sources were also used to determine if individual sources in other sources categories were major contributors to $SO_2$ emissions in each AoI.

Virginia elected to focus on those units that contributed at least 1% to sulfate visibility impairment at a given class I area. The units with the larger contribution toward visibility impairment would likely show an environmental benefit under a control evaluation, and Virginia would be able to use that environmental benefit to require controls on a given unit. Also, there are several regulatory programs that use a 1% threshold or higher for evaluation cutoffs.

1. The BART rule specifies that a maximum impact of 0.5 dv is an acceptable threshold for establishing significance. This threshold equates to roughly a 5% change in visible perception. The Prevention of Significant Deterioration/New Source Review program uses this same significance level for the visibility air quality related value.

2. The $NO_X$ SIP Call specified a significance level for § 126 petitions of 4 parts per billion (ppb), that being the level to which a state's contribution to another state's ozone problem was considered significant. Four ppb represents approximately 3.75% of the 1-hour ozone standard of 0.12 parts per million (ppm), which was in place at the time EPA promulgated the $NO_X$ SIP Call.

3. For the CAIR rule, a $PM_{2.5}$ contribution of 0.2 micrograms per cubic meter ($\mu g/m^3$) was used to demonstrate a significant impact, which is 1.3% of the annual 1997 $PM_{2.5}$ National Ambient Air Quality Standards (NAAQS) of 15.0 $\mu g/m^3$.

4. Lastly, when human health standards are proposed, significant impact levels (SILs) are assigned that allow sources to determine their significance on air quality in the area around their facilities. Sources that demonstrate that their "contribution" from the new or modified units is less than these significance levels do not have to complete any further modeling. The SILs represent a percentage of the NAAQS. After reviewing all averaging periods for the criteria pollutants, Virginia determined that the 1% threshold for reasonable further progress was at least as protective as the significant impact levels. The most restrictive threshold identified was for the annual nitrogen dioxide ($NO_2$)

NAAQS, which is set at 53 ppb or 100 μg/m$^3$. This annual NAAQS has a SIL of 1 μg/m$^3$, or 1% of the standard. This pollutant also has an hourly NAAQS standard of 100 ppb that was finalized in 2010. The hourly $NO_2$ NAAQS has an interim significance level of 4 ppb, which represents 4% of the standard.

Finally, consideration of available resources to evaluate the units in each class I area's sulfate AoI was necessary. Sufficient time and resources were not available to evaluate all units within a given AoI, and therefore, a threshold was needed to determine which units would be evaluated. Table 10 shows that a 1% contribution threshold captures nearly 50% of the total calculated point source $SO_2$ contribution to James River Face Wilderness area and just over 44% of the total calculated point source $SO_2$ contribution to Shenandoah National Park, while requiring an evaluation of 12 and 18 units, respectively. The evaluation of additional units with visibility contribution cutoffs between 0.1% and 1% would necessitate the review of another 152 and 167 units, respectively. Since resource constraints do not allow for the unit-by-unit review of hundreds of emissions points, using a 1% cutoff to create the list of facilities subject to a reasonable progress review was appropriate and allowed attention to be focused on those units responsible for the largest portion of calculated visibility impairment.

**Table 10: Emissions Points and Percent Contributions**

| Visibility Contribution Cutoff | Total # of Points for RP review | Total % contribution Reviewed |
|---|---|---|
| **James River Face** | | |
| ≥ 1% | 12 | 49.9% |
| ≥0.1% and < 1% | 152 | 41.2% |
| <0.1% | 172 | 8.9% |
| **Shenandoah** | | |
| ≥ 1% | 18 | 44.3% |
| ≥0.1% and < 1% | 167 | 49% |
| <0.1% | 147 | 6.7% |

## 2.3. Current Reasonable Progress Goals

The RHR at 40 CFR 51.308(d)(1) required states to establish RPGs for each class I area within the state (expressed in dv) that provide for reasonable progress toward achieving natural visibility. In addition, EPA released guidance on June 7, 2007, to use in setting reasonable progress goals. The goals were required to provide for improvement in visibility for the most impaired days and to ensure no degradation in visibility for the least impaired days over the SIP period.

In accordance with the requirements of 40 CFR 51.308(d)(1), the Virginia Regional Haze SIP established RPGs for Virginia's class I areas. To calculate the rate of progress represented by each RPG, Virginia compared baseline visibility conditions to natural visibility conditions in each class I area and determined the uniform rate of visibility improvement (in dv) that would need to be maintained during each implementation period in order to attain natural visibility conditions by 2064. The RPGs were based on the "Best and Final" Base G4a modeling results, and represented the best data available at the time of submittal, which was October 4, 2010.

**Table 11: Virginia Reasonable Progress Goals**

| Class I Area | Natural Conditions, dv | Baseline Visibility, dv * | | Expected Visibility by 2018, dv | | Reasonable Progress Goal Base G4a (Improvement by 2018) dv | Deciview Improvement Needed from Base G4a 2018-2064 |
|---|---|---|---|---|---|---|---|
| | | | | Base G2 | Base G4a | | |
| James River Face Wilderness Area | 11.1 | 20% WD | 29.1 | 22.6 | 22.4 | Δ 6.7 dv | Δ 11.0 |
| | 4.4 | 20% BD | 14.2 | 12.5 | 12.4 | Δ 1.8 dv | --- |
| Shenandoah National Park | 11.4 | 20% WD | 29.3 | 22.1 | 21.9 | Δ 7.4 dv | Δ 10.8 |
| | 3.1 | 20% BD | 10.9 | 8.8 | 8.7 | Δ 2.2 dv | --- |

**WD=Worst Day, BD=Best Day*

# 3. Progress Report

40 CFR 51.308(g) requires the state to submit:

> [A] report to the Administrator every 5 years evaluating progress towards the reasonable progress goals for each mandatory Class I Federal area located within the State and in each mandatory Class I Federal area located outside the State which may be affected by emissions from within the state.

Figure 10 illustrates the federal class I areas located within VISTAS/SEMAP, as well as the neighboring class I areas that may be affected by emissions from within Virginia.

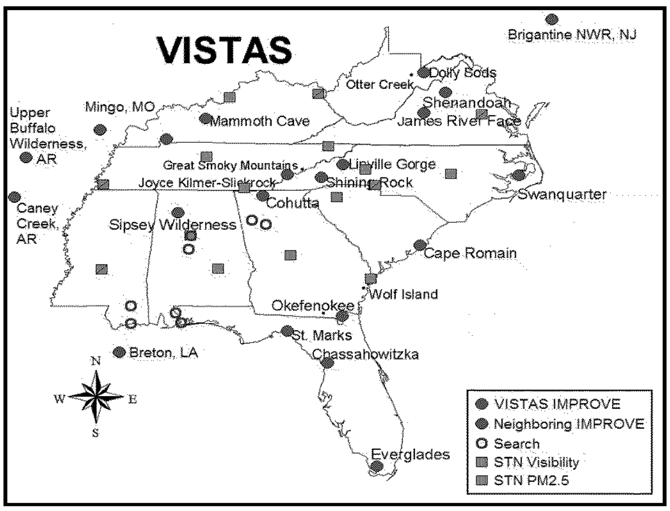


**Figure 10: VISTAS and Neighboring Class I Areas and Monitoring Locations**

## 3.1. Status of Measures in the Virginia Regional Haze SIP

40 CFR 51.308(g)(1) requires the state to submit:

> A description of the status of implementation of all measures included in the implementation plan for achieving reasonable progress goals for Class I areas both within and outside the state.

This summary provides a status of the emission reduction measures that were included in the VISTAS Regional Haze "Best and Final" Emissions Inventory and reasonable progress goal modeling effort. This report covers the time period from 2008 through 2013 and includes discussions of benefits associated with each measure. Such benefits are quantified wherever possible. In instances where implementation of a measure did not occur in a timely manner, information is provided on the source category and its relative impact on the overall future year emissions inventories.

The following also contains information on emissions strategies that were not included in the "Best and Final" emissions inventory and modeling effort. At the time of the "Best and Final" emissions inventory development process, these measures were not fully documented or had not yet been published in final form. Therefore the benefits of these measures were not included in future year inventories. Emissions reductions from these measures will help ensure that each class I area meets or exceeds the visibility RPGs set in the Virginia Regional Haze SIP.

### *3.1.1. Federal Programs*

The emission reductions associated with the federal programs described below were included in the VISTAS future year emissions estimates. Descriptions contain qualitative assessments of emission reductions associated with each program, and where possible, quantitative assessments. In cases where delays or modifications altered emissions reduction estimates such that the original estimates are no longer accurate, information is also provided on the effects of these alterations.

#### 3.1.1.1 Clean Air Interstate Rule and the Cross State Air Pollution Rule

On May 12, 2005 (70 FR 25162), EPA promulgated CAIR, which required reductions in emissions of $NO_X$ and $SO_2$ from large fossil fuel-fired EGUs. The US Court of Appeals for the DC Circuit ruled on petitions for review of CAIR and CAIR Federal Implementation Plans, including the provisions establishing the CAIR $NO_X$ and $SO_2$ trading programs. On July 11, 2008, the Court issued an opinion vacating and remanding these rules. However, parties to the litigation requested rehearing of aspects of the Court's decision, including the vacatur of the rules. On December 23, 2008, the Court remanded the rules to EPA without vacating them. The December 23, 2008, ruling left CAIR in place until EPA issued a new rule to replace CAIR in accordance with the July 11, 2008 decision.

On August 8, 2011 (76 FR 48208), EPA finalized the Transport Rule, commonly referred to as the Cross-State Air Pollution Rule (CSAPR). EPA intended for this rule to replace CAIR beginning in 2012, and the rule required 27 states in the eastern half of the United States to reduce power plant emissions. EPA also issued a supplemental proposal for six states to make ozone season $NO_X$ reductions. This brought the total number of states participating in the program to 28. CSAPR was estimated to reduce 2005 emissions from EGUs by 6,500,000 tons of $SO_2$ annually and 1,400,000 tons of $NO_X$ annually in the covered states. These estimates represented a 71% reduction in $SO_2$ and a 52% reduction in $NO_X$ from 2005 levels.

On December 30, 2011, the US Court of Appeals for the DC Circuit issued a ruling staying CSAPR pending judicial review. On August 21, 2012, the court vacated CSAPR, although on June 24, 2013, the U.S. Supreme Court issued an order granting petitions for review of this judgment. In the vacature, the court ordered EPA to "continue administering CAIR pending the promulgation of a valid replacement" (EME Homer City Generation, L.P. v. EPA, No. 11-1302). Therefore, CAIR remains in place and enforceable until replaced by a "valid" rule. Virginia's Regional Haze SIP identifies CAIR as a control measure that is expected to achieve significant visibility improvements by 2018. Virginia's CAIR program was submitted to EPA on March 30, 2007 and approved by EPA into the SIP on Decmeber 28, 2007 (72 FR 73602). The most recent updates to the CAIR program were submitted on September 27, 2010 and approved on August 22, 2011 (76 FR 52275). To the extent that Virginia is relying on CAIR in the Virginia Regional Haze SIP, the same logic applies as it relates to reliance on CAIR in the Huntington, West Virginia maintenance plan, as EPA explained on November 15, 2012 in the proposed "Approval and Promulgation of Air Quality Implementation Plans; West Virginia; Redesignation of the West Virginia Portion of the Huntington-Ashland, WV-KY-OH 1997 Annual PM2.5 Nonattainment Area to Attainment and Approval of the Associated Maintenance Plan" (77 FR 68076:

> [T]he recent directive from the DC Circuit in EME Homer ensures that the reductions associated with CAIR will be permanent and enforceable for the necessary time period. EPA has been ordered by the Court to develop a new rule and the opinion makes clear that after promulgating that new rule EPA must provide states an opportunity to draft and submit SIPs to implement that rule. CAIR thus cannot be replaced until EPA has promulgated a final rule through a notice-and-comment rulemaking process, states have had an opportunity to draft and submit SIPs, EPA has reviewed the SIPs to determine if they can be approved, and EPA has taken action on the SIPs, including promulgating a FIP [federal implementation plan] if appropriate. These steps alone will take many years, even with EPA and the states acting expeditiously. The Court's clear instruction to EPA that it must continue to administer CAIR until a "valid replacement" exists provides an additional backstop; by definition, any rule that replaces CAIR and meets the Court's direction would require upwind states to eliminate significant downwind contributions.
>
> Further, in vacating CSAPR and requiring EPA to continue administering CAIR, the DC Circuit emphasized that the consequences of vacating CAIR "might be more severe now in light of the reliance interests accumulated over the intervening four years." EME Homer, slip op. at 60. The accumulated reliance interests include the interests of states who reasonably assumed they could rely on reductions associated with CAIR, which brought certain areas into attainment with the NAAQS. If EPA were prevented from relying on reductions associated with CAIR in redesignation actions, states would be forced to impose additional, redundant reductions on top of those achieved by CAIR. EPA believes this is precisely the type of irrational result the court sought to avoid by ordering EPA to continue administering CAIR. For these reasons also, EPA believes it is appropriate to allow states to rely on CAIR, and the existing emissions reductions achieved by CAIR, as sufficiently permanent and enforceable pending a valid replacement rule for purposes such as redesignation. Following promulgation of

the replacement rule, EPA will review SIPs as appropriate to identify whether there are any issues that need to be addressed.

### 3.1.1.2 Maximum Achievable Control Technology Programs

VISTAS applied controls to future year emissions estimates from various Maximum Achievable Control Technology (MACT) regulations for VOCs, $SO_2$, $NO_x$, and PM on source categories where controls were installed on or after 2002. Control estimates are documented in the report entitled "Control Packet Development and Data Sources," Alpine Geophysics, July 14, 2004. Table 12 describes the MACTs used as control strategies for the non-EGU point source emissions.

**Table 12: MACT Source Categories with Compliance Dates on or after 2002**

| MACT Source Category | 40 CFR 63 Subpart | Date Promulgated | Existing Source Compliance Date | Pollutants Affected |
|---|---|---|---|---|
| Hazardous Waste Combustion (Phase I) | EEE | 9/30/99 | 9/30/03 | PM |
| Oil & Natural Gas Production | HH | 6/17/99 | 6/17/02 | VOC |
| Polymers and Resins III | OOO | 1/20/00 | 1/20/03 | VOC |
| Portland Cement Manufacturing | LLL | 6/14/99 | 6/10/02 | PM |
| Publicly Owned Treatment Works (POTW) | VVV | 10/26/99 | 10/26/02 | VOC |
| Secondary Aluminum Production | RRR | 3/23/00 | 3/24/03 | PM |
| Combustion Sources at Kraft, Soda, and Sulfite Pulp & Paper Mills (Pulp and Paper MACT II) | MM | 1/12/01 | 1/12/04 | VOC |
| Municipal Solid Waste Landfills | AAAA | 1/16/03 | 1/16/04 | VOC |
| Coke Ovens | L | 10/27/93 | Phased from 1995-2010 | VOC |
| Coke Ovens: Pushing, Quenching, and Battery Stacks | CCCCC | 4/14/03 | 4/14/06 | VOC |
| Asphalt Roofing Manufacturing and Asphalt Processing (two source categories) | LLLLL | 4/29/03 | 5/1/06 | VOC |
| Metal Furniture (Surface Coating) | RRRR | 5/23/03 | 5/23/06 | VOC |
| Printing, Coating, and Dyeing of Fabrics | OOOO | 5/29/03 | 5/29/06 | VOC |
| Wood Building Products (Surface Coating) | QQQQ | 5/28/03 | 5/28/06 | VOC |
| Lime Manufacturing | AAAAA | 1/5/04 | 1/5/07 | PM, $SO_2$ |
| Site Remediation TSDF | GGGGG | 10/8/03 | 10/8/06 | VOC |
| Iron & Steel Foundries | EEEEE | 4/22/04 | 04/23/07 | VOC |
| Taconite Iron Ore Processing | RRRRR | 10/30/03 | 10/30/06 | PM, $SO_2$ |
| Miscellaneous Coating Manufacturing | HHHHH | 12/11/03 | 12/11/06 | VOC |
| Metal Can (Surface Coating) | KKKK | 11/13/03 | 11/13/06 | VOC |
| Plastic Parts and Products (Surface Coating) | PPPP | 4/19/04 | 4/19/07 | VOC |
| Miscellaneous Metal Parts and Products (Surface Coating) | MMMM | 1/2/04 | 1/2/07 | VOC |

| MACT Source Category | 40 CFR 63 Subpart | Date Promulgated | Existing Source Compliance Date | Pollutants Affected |
|---|---|---|---|---|
| Industrial Boilers, Institutional/ Commercial Boilers and Process Heaters (ICI) | DDDDD | 9/13/04 | 9/13/07 | PM $SO_2$ |
| Plywood and Composite Wood Products | DDDD | 7/30/04 | 10/1/07 | VOC |
| Reciprocating Internal Combustion Engines | ZZZZ | 6/15/04 | 6/15/07 | $NO_X$, VOC |
| Auto and Light-Duty Truck (Surface Coating) | IIII | 4/26/04 | 4/26/07 | VOC |
| Wet Formed Fiberglass Mat Production | HHHH | 4/11/02 | 4/11/05 | VOC |
| Metal Coil (Surface Coating) | SSSS | 6/10/02 | 6/10/05 | VOC |
| Paper and Other Web Coating (Surface Coating) | JJJJ | 12/4/02 | 12/4/05 | VOC |
| Petroleum Refineries | UUU | 4/11/02 | 4/11/05 | VOC |
| Miscellaneous Organic Chemical Production (MON) | FFFF | 11/10/03 | 05/10/08 | VOC |

Use of the industrial/commercial/institutional (ICI) boiler MACT for major sources (subpart DDDDD) was problematic in that the US Court of Appeals for the DC Circuit vacated and remanded that regulation to EPA on June 8, 2007. However, VISTAS chose to leave the emissions reductions associated with this regulation in place since the CAA required use of alternative control methodologies under § 112(j) for uncontrolled source categories. The applied MACT control efficiencies were 4% for $SO_2$ and 40% for $PM_{10}$ and $PM_{2.5}$ to account for the co-benefit from installation of acid gas scrubbers and other control equipment to reduce hazardous air pollutants (HAPs).

To determine how the vacatur of this regulation may have affected the VISTAS future year inventories, VISTAS created an analysis of inventory data to determine the level of $SO_2$, $PM_{10}$, and $PM_{2.5}$ reductions associated with the vacated regulation. Table 13 compares the level of emission reductions for VISTAS in 2009 and 2018 estimated to be derived from the vacated regulation to the total non-EGU point source inventory for those years and to the total annual inventory for those years.

**Table 13: ICI Boiler MACT Reductions compared to the 2009 and 2018 VISTAS Inventory**

| Pollutant | ICI Boiler MACT Estimated Reductions in VISTAS States[1] | | Non-EGU Inventories for VISTAS States[2] | | Total Inventories for VISTAS States[2] | |
|---|---|---|---|---|---|---|
| | 2009 | 2018 | 2009 | 2018 | 2009 | 2018 |
| Primary $PM_{10}$, tpy | 13,325 | 14,556 | 211,267 | 248,367 | 4,161,695 | 4,549,680 |
| Primary $PM_{2.5}$, tpy | 10,892 | 11,919 | 157,615 | 185,490 | 1,124,150 | 1,195,487 |
| $SO_2$, tpy | 7,773 | 8,188 | 548,196 | 575,716 | 3,468,899 | 2,169,773 |

(1)ICI Boiler MACT reduction estimates are taken from "VISTAS Boiler_MACT_20080611.xls."
(2)Data from "Documentation of the Base G2 and Best & Final 2002 Base Year, 2009 and 2018 Emission Inventories for VISTAS-Revision 1," April 9, 2008 Table 2.1-15, Table 2.1-19, Table 2.1-20, and Appendix A.

The emission reductions associated with the vacated ICI boiler MACT were a very small percentage of overall non-EGU and total inventory emissions for each of the affected pollutants. On January 31, 2013 (78 FR 7138), EPA finalized the revised ICI boiler MACT for major sources (subpart DDDDD of 40 CFR Part 60), and on February 1, 2013 (78 FR 7488), EPA finalized the revised ICI boiler MACT for area sources (subpart JJJJJJ of 40 CFR Part 60). EPA estimated that implementation of the revised rulemakings would reduce emissions nationwide from these source categories by 18,000 tons per year (tpy) of PM and 580,000 tpy of $SO_2$.

#### 3.1.1.3 2007 Heavy-duty Highway Rule

In this regulation (subpart P of 40 CFR Part 86), EPA set a PM emissions standard for new heavy-duty engines of 0.01 grams per break horsepower-hour (g/bhp-hr), which took full effect for diesel engines in the 2007 model year. This rule also included standards for $NO_X$ and nonmethane hydrocarbons (NMHC) of 0.20 g/bhp-hr and 0.14 g/ bhp-hr, respectively. These diesel engine $NO_X$ and NMHC standards were successfully phased in together between 2007 and 2010. The rule also required that sulfur in diesel fuel be reduced to facilitate the use of modern pollution-control technology on these trucks and buses. EPA required a 97% reduction in the sulfur content of highway diesel fuel from 500 ppm (low sulfur diesel) to 15 ppm (ultra-low sulfur diesel). These requirements were successfully implemented on the timeline in the regulation.

#### 3.1.1.4 Tier 2 Vehicle and Gasoline Sulfur Program

EPA's Tier 2 fleet averaging program (subpart H of 40 CFR Part 80, 40 CFR Part 85, 40 CFR Part 86) for on-road vehicles became effective in the 2005 model year. The Tier 2 program allows manufacturers to produce vehicles with emissions ranging from relatively dirty to very clean, but the mix of vehicles a manufacturer sells each year must have average $NO_X$ emissions below a specified value. Mobile emissions continue to benefit from this program as motorists replace older, more polluting vehicles with cleaner vehicles.

#### 3.1.1.5 Nonroad Diesel Emissions Program

EPA adopted standards under 40 CFR Part 89 for emissions of $NO_X$, hydrocarbons, and carbon monoxide (CO) from several groups of nonroad engines, including industrial spark-ignition engines and recreational nonroad vehicles. Industrial spark-ignition engines power commercial and industrial applications and include forklifts, electric generators, airport baggage transport vehicles, and a variety of farm and construction applications. Nonroad recreational vehicles include snowmobiles, off-highway motorcycles, and all-terrain vehicles. These rules were initially effective in 2004 and were fully phased in by 2012.

The nonroad diesel rule set standards that reduced emissions by more than 90% from nonroad diesel equipment and, beginning in 2007, the rule reduced fuel sulfur levels by 99% from previous levels. The reduction in fuel sulfur levels applied to most nonroad diesel fuel in 2010 and applied to fuel used in locomotives and marine vessels in 2012.

### *3.1.2. EGU Federal Consent Decrees*

The following federal consent decrees with major utilities contain remedies that imposed control requirements or other reductions in future year emissions. Many of these requirements were taken into account in the VISTAS 2018 "Best and Final" Inventory. Consent decrees that have been executed since 2008, and therefore were not included in the initial Regional Haze SIP, are discussed in section 3.2.6.

- Santee Cooper (US District Court of South Carolina, Charleston Division): A 2004 consent agreement called for Santee Cooper to install and commence operation of continuous emission control equipment for $PM/SO_2/NO_X$ emissions; comply with system-wide annual $PM/SO_2/NO_X$ emissions limits; agree not to buy, sell, or trade allowances allocated to Santee Cooper System as a result of said agreement; and to comply with emission unit limits of said agreement.

- TECO (US District Court, Middle District of Florida): Under a settlement agreement, by 2008, Tampa Electric installed permanent emissions control equipment to meet stringent pollution limits; implemented a series of interim pollution-reduction measures to reduce emissions while the permanent controls were designed and installed; and retired pollution emission allowances that Tampa Electric or others could use, or sell to others, to emit additional $NO_X$, $SO_2$, and PM.

- VEPCO (US District Court, Eastern District of Virginia): Virginia Electric and Power Co. agreed to spend $1.2 billion by 2013 to eliminate 237,000 tons of $SO_2$ and $NO_X$ emissions each year from eight coal-fired electricity generating plants in Virginia and West Virginia.

- Gulf Power 7 (State of Florida "Agreement for the Purpose of Ensuring Compliance with the Ozone Ambient Air Quality Standards"): A 2002 agreement called for Gulf Power to upgrade its operation to cut $NO_X$ emission rates by 61% at its Crist 7 generating plant by 2007, with major reductions beginning in early 2005.

- EKPC (US District Court, Eastern District of Kentucky, Central Division, Lexington): A July 2, 2007 consent agreement between EPA and East Kentucky Power Cooperative required the utility to reduce its emissions of $SO_2$ by 54,000 tpy at the utility's Spurlock, Dale, and Cooper plants. The consent decree required $NO_X$ emission reductions of 8,000 tpy and the installation of $NO_X$ control equipment as well as the installation and operation of PM and mercury continuous emissions monitors at these facilities. According to EPA, total emissions will decrease between 50% and 75% from 2005 levels. The utility is precluded from using reductions required under other programs, such as CAIR, to meet the reduction requirements of the consent decree.

- Alabama Power (US District Court, Northern District of Alabama, Southern Division): Under a 2006 Partial Consent Decree, Alabama Power agreed to spend approximately $200 million by 2012 to install pollution controls on Plant Miller Units 3 and 4. The agreement caused APC to reduce approximately 28,000 tons per year of emissions of $SO_2$ and $NO_X$ from Plant Miller.

- AEP (US District Court for the Southern District of Ohio, Eastern Division): American Electric Power agreed to spend $4.6 billion dollars to eliminate 72,000 tons of $NO_X$

emissions each year by 2016 and 174,000 tons of $SO_2$ emissions each year by 2018 from sixteen plants located in Indiana, Kentucky, Ohio, Virginia, and West Virginia.

### *3.1.3. Non-EGU Federal Consent Decrees*

The VISTAS 2009 and 2018 emissions inventories took into account unit specific requirements from several federal consent orders applicable to source types other than electrical generation, as described below.

- Dupont (US District Court for the Southern District of Ohio): A 2007 agreement called for E. I. Dupont Nemours & Company's James River plant, located in Virginia, to install dual absorption pollution control equipment by September 1, 2009, resulting in emission reductions of approximately 1,000 tons $SO_2$ annually. The sulfuric acid plant emitted 1,145 tons of $SO_2$ in 2002. In 2009, the year in which controls were applied, the plant emitted 379 tons of $SO_2$.

- Stone Container (US District Court, Eastern District of Virginia): A 2004 agreement required the West Point Paper Mill owned by Smurfit/Stone Container and located in West Point, Virginia, to control $SO_2$ emissions from the #8 Power Boiler with a wet scrubber. The scrubber was installed and operational by October of 2007. Emissions of $SO_2$ from the facility during 2002 were 4,575 tpy. Emissions of $SO_2$ from the facility during 2009, after installation of the scrubber, were 1,009 tpy.

### *3.1.4. State EGU Control Strategies*

Emissions from EGUs have been regulated through a number of mechanisms, including state programs. Reductions associated with many of these mechanisms were used in the estimates of visibility improvements by 2018 at the VISTAS class I areas.

#### 3.1.4.1 North Carolina Clean Smokestacks Act

In June 2002, the North Carolina General Assembly enacted the Clean Smokestacks Act, which required significant actual emissions reductions from coal-fired power plants in North Carolina. Under the act, power plants must reduce their $NO_X$ emissions by 77% in 2009 and their $SO_2$ emission by 73% in 2013. Actions taken to date by facilities subject to these requirements comply with the provisions of the Clean Smokestacks Act, and compliance plans and schedules will allow these entities to achieve the emissions limitations set out by the Act. This program has been highly successful. In 2009, regulated entities emitted less than the 2013 system annual cap of 130,000 tons of $SO_2$ and less than the 2009 system annual cap of 56,000 tons of $NO_X$.

#### 3.1.4.2 Georgia Multi-Pollutant Control for Electric Utility Steam Generating Units

Georgia rule 391-3-1.02(2)(sss), enacted in 2007, requires flue gas desulfurization (FGD) and SCR controls on coal-fired EGUs in Georgia. These controls will reduce $SO_2$ emissions from the affected emissions units by at least 95% and will reduce $NO_X$ emissions by approximately 85%. Control implementation dates vary by EGU, starting on December 31, 2008.

### *3.1.5. Review of BART Determinations*

The VISTAS "Best and Final" 2018 emissions inventories contained emissions reductions expected to be achieved from BART determinations made by the member states. Figure 11 shows the 300 km radius around the James River Face Wilderness Area and Shenandoah National Park. This figure also depicts the facilities in nearby states containing units that are subject to BART. Each facility is identified in Table 14.

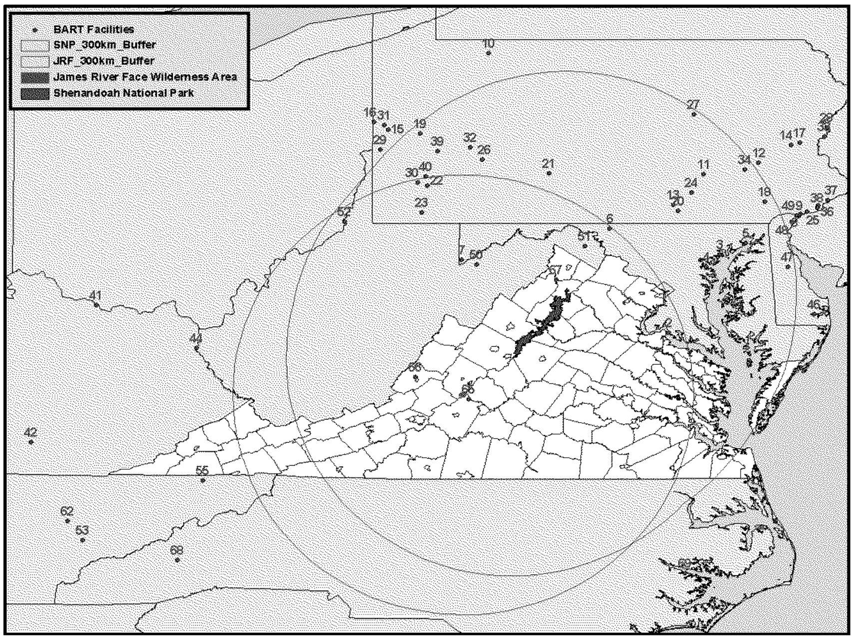


**Figure 11: Locations of BART Facilities in Adjacent States Within a 300 km Radius of James River Face and Shenandoah**

**Table 14: BART Facility Identification**

| Index ID | State | Facility Name | Facility ID | ORIS |
|---|---|---|---|---|
| 1 | MD | Chalk Point | 24-033-0014 | 1571 |
| 2 | MD | Morgantown | 24-017-0014 | 1573 |
| 3 | MD | Crane | 24-005-0079 | 1552 |
| 4 | MD | Wagner | 24-003-0014 | 1554 |
| 5 | MD | New Page/Luke Paper | 24-003-0014 | 50282 |
| 6 | MD | St Lawrence Cement | 24-043-0008 | |
| 7 | MD | Mettiki Coal | 24-023-0042 | |
| 8 | PA | Conoco Phillips | 42-045-0030 | 880025 |
| 9 | PA | Sunoco Marcus Hooker | 42-045-0025 | 999999 |
| 10 | PA | United Refining Company | 42-123-0003 | |
| 11 | PA | Carmeuse | 42-075-0016 | |
| 12 | PA | Lehigh Cement - Evansville | 42-011-0039 | |
| 13 | PA | Lehigh Cement - York | 42-133-0060 | |
| 14 | PA | LeFarge Whitehall | 42-077-0019 | |
| 15 | PA | CEMEX Wampum | 42-073-0024 | |
| 16 | PA | ESSROC-Bessemer | 42-073-0026 | |
| 17 | PA | Keystone Cement - East Allen | 42-095-0012 | |
| 18 | PA | ISG Plate - Coatesvilles | 42-029-0024 | |
| 19 | PA | AK Steel - Butter | 42-019-0007 | |
| 20 | PA | P.H. Glatfelter - Spring Grove | 42-133-0016 | 50397 |
| 21 | PA | Appleton Papers - Spring Mill | 42-013-0010 | |

| Index ID | State | Facility Name | Facility ID | ORIS |
|---|---|---|---|---|
| 22 | PA | Dyno Nobel - Donora | 42-125-0008 | |
| 23 | PA | Allegheny Energy - Hatfields Ferry | 42-059-0006 | 3179 |
| 24 | PA | PPL Bruner Island | 42-133-0020 | 3140 |
| 25 | PA | Exelon Eddystone | 42-045-0014 | 3161 |
| 26 | PA | EME Homer | 42-063-0003 | 3122 |
| 27 | PA | PPL Montour | 42-093-0003 | 3149 |
| 28 | PA | Reliant Energy - Portland | 42-095-0011 | 3113 |
| 29 | PA | First Energy - Bruce Mansfield | 42-007-0005 | 6094 |
| 30 | PA | Allegheny Energy - Mitchell | 42-125-0014 | 3181 |
| 31 | PA | Orion Power - New Castle | 42-073-0025 | 3138 |
| 32 | PA | Reliant Energy - Keystone | 42-005-0012 | 3136 |
| 33 | PA | PPL Martins Creek | 42-095-0010 | 3148 |
| 34 | PA | Reliant Energy - Conemaugh | 42-063-0001 | 3118 |
| 35 | PA | Trigen Edison | 42-101-04902 | 880006 |
| 36 | PA | Trigen Schuylkill | 42-101-04942 | 50607 |
| 37 | PA | Sunoco Frankfurt | 42-101-01551 | 880007 |
| 38 | PA | Sunoco Philadelphia | 42-010-1501 | 52106 |
| 39 | PA | Allegheny Ludlum | 42-003-00093 | |
| 40 | PA | US Steel - Clairton | 42-003-00032 | |
| 41 | KY | EKPC Spurlock Station | | 6041 |
| 42 | KY | EKPC Cooper Station | | 1384 |
| 43 | KY | TVA Paradise | | 1378 |
| 44 | KY | AEP Big Sandy | | 1353 |
| 45 | KY | E.ON U.S Mill Creak Station | | 1364 |
| 46 | DE | NRG Indian River | 10-005-00001 | 594 |
| 47 | DE | City of Dover - McKee Run | 10-001-00002 | 599 |
| 48 | DE | Conectiv - Edge Moor | 10-003-00007 | 593 |
| 49 | DE | Claymont Steel | 10-003-00063 | |
| 50 | WV | Dominion - Mount Storm | 54-023-00003 | 3954 |
| 51 | WV | Capitol Cement | 54-003-00006 | |
| 52 | WV | PPG | 54-051-00002 | |
| 53 | TN | Alcoa - South Plant | 47-009-0008 | |
| 54 | TN | DuPont White Pigment and Mineral Products | 47-085-0007 | |
| 55 | TN | Eastman Chemical Company | 47-163-0003 | |
| 56 | TN | E I DuPont de Nemours - Old Hickory | 47-037-0002 | |
| 57 | TN | E I DuPont de Nemours - Shelby | 47-157-0097 | |
| 58 | TN | Lucite International | 47-157-00475 | |
| 59 | TN | Owens Corning | 47-113-0024 | |
| 60 | TN | Packaging Corporation of America | 47-071-0002 | |
| 61 | TN | PCA Nitrogen | 47-157-00146 | |
| 62 | TN | TVA - Bull Run | 47-001-0009 | |
| 63 | TN | TVA - Cumberland | 47-161-0011 | |
| 64 | TN | Zinifex | 47-125-0092 | |
| 65 | VA | Georgia Pacific - Big Island | 51-019-0003 | 50479 |
| 66 | VA | MeadWestvaco - Covington | 51-580-0003 | 50900 |
| 67 | VA | O-N Minerals (Global Chemstone) | 51-171-00003 | |
| 68 | NC | Blue Ridget Paper | 37-087-00159 | |
| 69 | NC | PCS Phosphate | 37-013-00071 | |

### 3.1.5.1 West Virginia

Table 15 lists the BART determinations made in West Virginia. More information on these determinations may be found in Chapter 7 of the "West Virginia Regional Haze State

Implementation Plan to Preserve, Protect and Improve Visibility in Class I Federal Areas," dated June 2008.

**Table 15: BART Determinations for Facilities in West Virginia within 300 km of the Virginia Class I Areas**

| WV BART Summary* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Mount Storm (54-023-00003)** | | | | | | | | |
| **Unit ID:** | **Pollutant** | **Control Method** | **Overall Control Efficiency** | **BART Limit** | **Compliance Date** | **2002 Emissions, tpy** | **2007 SEMAP Emissions, tpy** | **2018 Projected Emissions, tpy** |
| Unit 1/001 | $PM_{10}$ filterable | ESP & FGD | 99.50% | 0.03 lb/mmbtu filterable | 12/13/2007 | 64 | 67 | 63 |
| Unit 2/0012 | $PM_{10}$ filterable | ESP & FGD | 99.50% | 0.03 lb/mmbtu filterable | 12/13/2007 | 67 | 70 | 64 |
| Unit 3/0013 | $PM_{10}$ filterable | ESP & FGD | 99.50% | 0.03 lb/mmbtu filterable | 12/13/2007 | 177 | 137 | 185 |
| **Capitol Cement (54-003-00006)** | | | | | | | | |
| **Unit ID:** | **Pollutant** | **Control Method** | **Overall Control Efficiency** | **BART Limit** | **Compliance Date** | **2002 Emissions, tpy** | **2007 SEMAP Emissions, tpy** | **2018 Projected Emissions, tpy** |
| #9 Kiln/012** | $SO_2$ | Shutdown | N/A | N/A | #9 kiln shutdown 3/22/2009. New kiln started 9/2009. | 211 | 1,586 | 289 |
| | $NO_X$ | | | | | 1,185 | 1,338 | 1,224 |
| | $PM_{10}$ | | | | | 130 | 44 | 180 |
| **PPG (54-051-00002)** | | | | | | | | |
| **Unit ID:** | **Pollutant** | **Control Method** | **Overall Control Efficiency** | **BART Exemption Limit** | **Compliance Date** | **2002 Emissions, tpy** | **2007 SEMAP Emissions, tpy** | **2018 Projected Emissions, tpy** |
| #5 Boiler/003 | $SO_2$ | Multiple | 58% | 1,478.8 lb/hr Limit designed for BART exemption, not BART determination | 5/1/2008 | 7,071 | 4,492 | 7,016 |

*Table information excerpted from Tables 7.8.b-4 and 7.8.c-1 of the" West Virginia Regional Haze State Implementation Plan to Preserve, Protect and Improve Visibility in Class I Federal Areas," June 2008.
**Kilns 7, 8, and 9 were replaced with a new kiln. Emissions in 2018 were included to represent possible emissions from new kiln.

### 3.1.5.2 North Carolina

Two facilities were subject to BART: Blue Ridge Paper in Canton, North Carolina and PCS Phosphate in Aurora, North Carolina. Both of these facilities are located more than 300 km from the Virginia class I areas. Existing controls at both facilities were deemed to be BART by North Carolina, as documented in Appendix L of the Regional Haze SIP for NC class I areas, dated December 17, 2007.

### 3.1.5.3 Pennsylvania

Pennsylvania is subject to the federal CAIR program for both annual $SO_2$ and $NO_X$ emissions. For units subject to BART that are EGUs, Pennsylvania conducted BART determinations on PM only. See section 8.2 of Pennsylvania Department of Environmental Protection's "Revision to the State Implementation Plan for Regional Haze," dated December 2010. Existing controls satisfied BART requirements for the BART-eligible sources in Pennsylvania. Chapter 8 of the plan provides more information on these BART determinations.

### 3.1.5.4 Maryland

Maryland conducted BART determinations for PM, $SO_2$, and $NO_X$ for all BART-eligible units. For the EGUs, Maryland determined that current controls satisfied BART and that Maryland's Healthy Air Act is an acceptable alternative program to BART. Non-EGU BART emission reduction summaries may be found in section 9.6.4 of Maryland's "Regional Haze State Implementation Plan," dated January 6, 2012. Compliance schedules for non-EGU BART requirements are within five years of SIP approval. For more information, see Chapter 9 and Appendix G of the above-referenced document.

### 3.1.5.5 Delaware

BART-eligible sources in Delaware consist of three EGU facilities and one non-EGU facility. The non-EGU facility received a cap on emissions of less than BART-eligibility thresholds. The three EGU facilities are regulated by Delaware's Regulation 1146, EGU Multi-Pollutant Regulation, a non-trading program regulation that was established as an aid to attaining the 1997 ozone NAAQS and the 1997 $PM_{2.5}$ NAAQS and to reduce mercury emissions. Delaware asserts in its implementation plan that Regulation 1146 is superior to a unit-by-unit BART analysis and is an alternative measure to BART for $SO_2$ and $NO_X$. Unit-by-unit BART determinations were made for PM. More information may be found in Delaware's "Visibility State Implementation Plan," dated September 24, 2008.

### 3.1.5.6 Kentucky and Tennessee

BART-eligible sources in Kentucky and Tennessee are located outside the range of 300 kilometers from any of the Virginia class I areas. BART determinations may be found in Appendix L of the State of Tennessee's "Regional Haze State Implementation Plan for Tennessee's class I Areas" and in Appendix L of the State of Kentucky's "Regional Haze State Implementation Plan For Kentucky's class I Area."

### 3.1.5.7 Virginia

The results of the BART determinations for facilities located in Virginia are listed in Table 16.

Table 16: Virginia BART Determinations

| Georgia Pacific – Big Island: Power Boiler #4 (Permit issued 6/12/08, partial SIP approval 6/13/12 (77 FR 3691) 51-019-0003 Stack 1 Point 1 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Pollutant** | **Short Term Limit** | **Long Term Limit** | **Control Efficiency** | **Work Practice or Control Device** | **Compliance Date** | **Comments/BART Status** | **2002 Emissions, tpy** | **2007 SEMAP Emissions, tpy** | **2018 Projected Emissions, tpy** |
| $SO_2$ | 50.0 lb/hr | 219.0 tpy | 90.0% | 1.8% S coal; Caustic scrubber | Scrubber and coal limitation effective 01/01/12. Short term limit effective 180 days after scrubber start up. Long term limit effective 07/01/13. | Facility has notified EPA and VDEQ that this unit retired as of December, 2011. | 1,090 | 1,432 | 122 |
| $NO_X$ | 169.0 lb/hr | 740.2 tpy | --- | LNB | At issuance. | | 531 | 250 | 214 |
| $PM/PM_{10}$ | 0.07 lb/mmbtu 19.9 lb/hr | 87.0 tpy | --- | ESP | At issuance. | | 5 | 23 | 3 |
| **Georgia Pacific – Big Island: Power Boiler #5 (Permit issued 6/12/08, partial SIP approval 6/13/12 (77 FR 3691) 51-019-0003 Stack 1 Point 2** | | | | | | | | | |
| **Pollutant** | **Short Term Limit** | **Long Term Limit** | **Control Efficiency** | **Work Practice or Control Device** | **Compliance Date** | **Comments/BART Status** | **2002 Emissions, tpy** | **2007 SEMAP Emissions, tpy** | **2018 Projected Emissions, tpy** |
| $SO_2$ | 485.1 lb/hr | 374.0 tpy | --- | 1.3% S coal; Good operational practice Firing coal no more than 10% of the annual capacity factor | Hourly limit effective at issuance. Annual limit effective 12 months after permit issuance (06/12/09). Coal S content limit effective 01/01/12. | Permit issued 6/12/2008. | 251 | 56 | 263 |
| $NO_X$ | 139.3 lb/hr | 610.1 tpy | --- | OFA | At issuance. | Existing control equipment. | 225 | 232 | 247 |
| $PM/PM_{10}$ | 0.07 lb/mmbtu 23.7 lb/hr | 103.9 tpy | --- | ESP | At issuance | Existing control equipment. | 12 | 38 | 16 |

| MeadWestvaco Power Boiler # 9 (PWR009) (Permit issued 2/23/09, partial SIP approval 6/13/12 (77 FR 3691) 51-580-0003 Stack 25 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Pollutant** | **Short Term Limit** | **Long Term Limit** | **Control Efficiency** | **Work Practice or Control Device** | **Compliance Date** | **Comments/BART Status** | **2002 Emissions, tpy** | **2007 SEMAP Emissions, tpy** | **2018 Projected Emissions, tpy** |
| $SO_2$ | 1,831 lb/hr on an annual average | 8,020 tpy | --- | FGD | At issuance or 01/01/09. | Existing equipment | 8,552 | 6,918 | 8,020 |
| $NO_X$ | 242.1 lb/hr | 1,060 tpy | --- | LNB | | Existing equipment | 710 | 800 | 1,030 |
| $PM/PM_{10}$ | 166.4 lb/hr 0.07 lb/mmbtu | 728.9 tpy | --- | ESP | | Existing equipment | 248 | 176 | 290 |

| MeadWestvaco Power Boiler #10 (PWR010) (Permit issued 2/23/09,partial SIP approval 6/13/12 (77 FR 3691) 51-580-0003 Stack 5 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Pollutant** | **Short Term Limit** | **Long Term Limit** | **Control Efficiency** | **Work Practice or Control Device** | **Compliance Date** | **Comments/BART Status** | **2002 Emissions, tpy** | **2007 SEMAP Emissions, tpy** | **2018 Projected Emissions, tpy** |
| $SO_2$ | --- | --- | --- | Fuel restriction of at least 90% natural gas utilization<br>Proper operation and maintenance | At issuance. | Implemented. | 0 | 0 | 0 |
| $NO_X$ | 66.0 lb/hr on natural gas | --- | --- | Operation at no more than 50% of rated capacity on annual basis.<br>Proper maintenance | | Implemented. | 46 | 10 | 209 |
| $PM/PM_{10}$ | 2.51 lb/hr on natural gas | --- | --- | Fuel restriction of at least 90% natural gas utilization<br>Proper operation and maintenance | | Implemented. | 1 | 0 | 1 |

| MeadWestvaco Power Recovery Furnace #1 (REC001) (Permit issued 2/23/09, partial SIP approval 6/13/12 (77 FR 3691) 51-580-0003 Stack 8 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Pollutant** | **Short Term Limit** | **Long Term Limit** | **Control Efficiency** | **Work Practice or Control Device** | **Compliance Date** | **Comments/BART Status** | **2002 Emissions, tpy** | **2007 SEMAP Emissions, tpy** | **2018 Projected Emissions, tpy** |
| $SO_2$ | 713.7 lb/hr | --- | --- | Proper boiler operation and maintenance | At issuance. | --- | 105 | 343 | 352 |
| $NO_X$ | 211.2 lb/hr | --- | --- | Proper boiler operation and maintenance | At issuance. | --- | 501 | 571 | 586 |
| $PM/PM_{10}$ | 0.044 gr/dscf @8% $O_2$<br>PM: 150.0 lb/hr<br>PM: 85.0 lb/hr annual average<br>$PM_{10}$: 103.8 lb/hr<br>$PM_{10}$: 58.8 lb/hr annual average | PM: 350 tpy<br>$PM_{10}$: 242 tpy | --- | ESP | At issuance. | Existing equipment. | 301 | 112 | 122 |

| MeadWestvaco Smelt Dissolving Tanks (REC002 and REC003) (Permit issued 2/23/09, partial SIP approval 6/13/12 (77 FR 3691) 51-580-0003 Stack 10 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Pollutant** | **Short Term Limit** | **Long Term Limit** | **Control Efficiency** | **Work Practice or Control Device** | **Compliance Date** | **Comments/BART Status** | **2002 Emissions, tpy** | **2007 SEMAP Emissions, tpy** | **2018 Projected Emissions, tpy** |
| $SO_2$ | 14.8 lb/hr | 64.8 tpy | --- | Venturi scrubber with basic solution | At issuance. | Existing equipment. | 70 | 40 | 82 |
| $NO_X$ | --- | --- | --- | | | | --- | --- | --- |
| $PM/PM_{10}$ | PM: 14.1 lb/hr<br>$PM_{10}$: 12.6 lb/hr | PM: 58.0 tpy<br>$PM_{10}$: 51.9 tpy | --- | | | | 19 | 12 | 22 |

| O-N Minerals (Global Chemstone) Rotary Kiln U5 (Permit issued 12/28/09, partial SIP approval 6/13/12 (77 FR 3691) 51-171-00003 Stack 2 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Pollutant** | **Short Term Limit** | **Long Term Limit** | **Control Efficiency** | **Work Practice or Control Device** | **Compliance Date** | **Comments/BART Status** | **2002 Emissions, tpy** | **2007 SEMAP Emissions, tpy** | **2018 Projected Emissions, tpy** |
| $SO_2$ | 14.7 lb/hr<br>0.29 lb/tsf | --- | --- | *Inherent process scrubbing or wet scrubber<br>*S content of fuel no greater than 1% | 09/10/11 or 08/01/12<br>Short term emissions limits effective 09/10/10. | | 2 | 2 | 3 |
| $NO_X$ | 87.0 lb/hr<br>1.74 lb/tsf | --- | --- | *Indirect firing<br>*Good combustion practices | At issuance. | | 256 | 259 | 336 |
| $PM/PM_{10}$ | 6.0 lb/hr<br>0.12 lb/tsf | --- | --- | *Multicyclone<br>*Fabric filter | At issuance. | | 15 | 15 | 15 |
| **O-N Minerals (Global Chemstone) Calcimatic Kiln U12 (Permit issued 12/28/09, partial SIP approval 6/13/12 (77 FR 3691) 51-171-00003 Stack 3** | | | | | | | | | |
| **Pollutant** | **Short Term Limit** | **Long Term Limit** | **Control Efficiency** | **Work Practice or Control Device** | **Compliance Date** | **Comments/BART Status** | **2002 Emissions, tpy** | **2007 SEMAP Emissions, tpy** | **2018 Projected Emissions, tpy** |
| $SO_2$ | 2.6 lb/hr<br>0.16 lb/tsf | --- | --- | *Venturi scrubber | At issuance. | Unit has been permanently shut down. | 0 | 0 | 0 |
| $NO_X$ | 9.8 lb/hr<br>0.61 lb/tsf | --- | --- | *Good combustion practices | At issuance. | Unit has been permanently shut down. | 24 | 0 | 31 |
| $PM/PM_{10}$ | 9.6 lb/hr<br>0.60 lb/tsf | ---- | --- | *Multicyclone<br>*Venturi scrubber | At issuance. | Unit has been permanently shut down. | 30 | 0 | 28 |

### *3.1.6. Reasonable Progress Determinations*

Regional air quality modeling projected that reductions in $SO_2$ from EGU and non-EGU point sources would result in the greatest improvements in visibility at VISTAS class I areas. Therefore, for this first round of regional haze planning, VISTAS chose to focus reasonable progress evaluations on potential $SO_2$ emission controls from these source sectors. To select the specific point sources that would be considered for each class I area, states first identified the geographic areas that most likely influenced visibility in each class I area and then identified the major $SO_2$ point sources in that geographic area. This area was defined as the $SO_2$ Area of Influence (AoI). VISTAS created detailed spreadsheets identifying $SO_2$ emissions by stack, distance from class I areas, and estimated sulfate extinction-weighted residence times.

To further aid in the reasonable progress analyses, AirControlNET results were used. AirControlNET, a control technology analysis tool developed to support EPA in its analyses of air pollution policies and regulations, provided data on emission sources, potential pollution control measures, emission reductions, and the costs of implementing those controls. Every available $SO_2$ control strategy in AirControlNET was run against the EGU and non-EGU point source inventories to develop a master list of available control strategies for VISTAS states to use in reasonable progress controls development. States reviewed stacks with an estimated calculated sulfate visibility contribution of at least 1% to any class I area to determine if further $SO_2$ controls were feasible. Virginia used a benchmark of approximately $2,000/ton of pollutant removed to determine economic feasibility. Units identified by AirControlNET as potentially having the opportunity for cost-effective control installation were asked to submit a reasonable progress four factor analysis. More detail on the methodology of the VISTAS reasonable progress analysis may be found in Appendix H of Virginia's Regional Haze SIP.

After review of all data, Virginia determined that one stack at one facility required further analysis to satisfy reasonable progress requirements during this round of regional haze planning. Table 17 provides information on the results of the reasonable progress review for this first round of regional haze planning.

**Table 17: Virginia Reasonable Progress Status**

| Facility & Stack ID | RP $SO_2$ Control Strategy | $SO_2$ Emission Limits | Compliance Date | 2002 Emissions, tpy $SO_2$ | 2007 SEMAP Emissions, tpy $SO_2$ | 2018 Emissions, tpy $SO_2$ | Status & Comment |
|---|---|---|---|---|---|---|---|
| MeadWestvaco 51-580-0003 Stack #25 | Improvements to existing FGD | 1,556.35 lb/hr<br>6,817 tpy | 01/01/2015 | 8,552 | 6,918 | 8,020 | Permit issued 5/4/11. SIP revision submitted to EPA 5/6/11. |

The reasonable progress analysis results were not known at the time of the "Best and Final" Modeling inventory development. Therefore, the stack was modeled at 8,020 tpy of $SO_2$ emissions for the final 2018 visibility milestones. Reductions associated with this analysis will help ensure that the class I areas in Virginia meet their 2018 visibility improvement goals.

### 3.2. Emission Control Measures Not Included in the Virginia Regional Haze SIP

Since development of the Virginia Regional Haze SIP, a number of regulations and requirements have been developed that were not included in 2018 estimates. The sections below provide information on these requirements, and where possible, estimates of additional reductions are provided. These reductions provide extra assurances that James River Face Wilderness Area and Shenandoah National Park will meet their reasonable progress goals in a timely manner.

#### *3.2.1. Mercury and Air Toxics Standards*

On February 16, 2012 (77 FR 9304) EPA promulgated the National Emission Standards for Hazardous Air Pollutants From Coal-Fired and Oil-Fired Electric Utility Steam Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial-Institutional, and Small Industrial-Commercial-Institutional Steam Generating Units. This rule is also known as the Mercury and Air Toxics Standards (MATS). The final rule established power plant emission standards for mercury, acid-gases, and non-mercury metallic toxic pollutants that will prevent 90% of the mercury in coal burned in power plants from being emitted into the air, reduce by 88% the acid gas emissions from power plants, and cut power plant $SO_2$ emissions by 41% beyond the reductions expected from CSAPR. These reductions are expected in the 2016 timeframe.

On November 30, 2012 (77 FR 71323), EPA proposed to update emission limits for new power plants MATS. The updates would only apply to future power plants, would not change the types of state-of-the-art pollution controls that they are expected to be installed, and would not significantly change costs or public health benefits of the rule.

#### *3.2.2. 2010 $SO_2$ NAAQS*

On June 2, 2010, EPA strengthened the primary NAAQS for $SO_2$ by revising the primary $SO_2$ standard to 75 ppb averaged over one hour. This short term standard is significantly more stringent than the revoked standards of 140 ppb averaged over 24 hours and 30 ppb averaged annually. Under the new standard, facilities with significant emissions of $SO_2$, many of which are EGUs, will be required to demonstrate compliance with the standard no later than 2017.

EPA plans to use a combination of monitoring and modeling to assess compliance with the 2010 $SO_2$ standard. EPA has proposed implementation and modeling guidance and held stakeholder meetings to gather information. These stakeholder discussions signaled the need to include potential alternatives to modeling for designations and compliance in EPA guidance. Any additional reductions in $SO_2$ emissions brought about by the 2010 $SO_2$ NAAQS will enhance protection of visibility in federal class I areas.

#### *3.2.3. North American Emission Control Areas*

On March 26, 2010, the International Maritime Organization officially designated waters off North American coasts as an area in which stringent international emission standards will apply to ships. These standards will reduce air pollution from ships and deliver air quality benefits that extend hundreds of miles inland. In 2020, EPA expects emissions from ships operating in the designated area to be reduced by 320,000 tons for $NO_X$, 90,000 tons for $PM_{2.5}$, and 920,000 tons for $SO_2$, which is 23%, 74%, and 86%, respectively, below predicted levels in 2020 absent the Emissions Control Area designation.

Implementation of the Emission Control Area means that ships entering the designated area would need to use compliant fuel for the duration of their voyage that is within that area, including time in port as well as voyages whose routes pass through the area without calling on a port. The requirements for quality of fuel change over time. From the effective date in 2012 until 2015, the sulfur content of fuel used by all vessels operating in designated areas cannot exceed 10,000 ppm. Beginning in 2015, the sulfur content of fuel used by vessels operating in these areas cannot exceed 1,000 ppm. With regard to $NO_X$ emissions, marine diesel engines installed on a ship constructed on or after January 1, 2011, must comply with the Tier II standard. Marine diesel engines installed on a ship constructed on or after January 1, 2015, will be required to comply with the more stringent Tier III $NO_X$ standard.

### *3.2.4. Residual Risk Requirements*

The CAA requires EPA to assess the risk remaining after application of final technology-based air toxics standards to any source category within eight years of setting the technology-based MACT standards. In the residual risk process, EPA must assess the remaining health risks from each source category to determine whether the MACT standards provide an ample margin of safety to protect public health and protect against adverse environmental effects. Final rules for this CAA requirement are expected for 28 source categories between 2011 and 2013. Additional requirements to reduce toxic air emissions under the residual risk assessment may also have co benefits for the reduction of VOC and other criteria pollutant emissions between now and 2018.

### *3.2.5. Control Technique Guidelines*

The CAA (§ 172(c)(1)) provides that SIPs for nonattainment areas must include reasonably available control techniques (RACT) for control of emissions that contribute to the formation of ozone air pollution. Section 182(b)(2) provides that for certain nonattainment areas, states must revise their SIPs to include RACT for sources of VOC emissions covered by a control techniques guidelines document (CTG). Section 183(e) then directs EPA to list for regulation those categories of products that account for at least 80% of the VOC emissions from commercial products in ozone nonattainment areas.

RACT controls for source categories controlled by a CTG are known as CTG RACTs. CTG RACTs have been issued for various printing, coating, and cleaning operations. In 2006, 2007, and 2008, EPA published CTGS as listed in Table 18. These regulations, which must be implemented in ozone nonattainment areas and the Ozone Transport Region within one year of becoming final, reduce emissions of VOCs from areas in which they are required.

**Table 18: CTGs Promulgated in 2006, 2007, and 2008**

| Category | EPA Document Number |
|---|---|
| Industrial Cleaning Solvents | EPA-453/R-06-001 |
| Offset Lithographic Printing and Letterpress Printing | EPA-453/R-06-002 |
| Flexible Package Printing | EPA-453/R-06-003 |
| Flat Wood Paneling Coatings | EPA-453/R-06-004 |
| Paper, Film, and Foil Coatings | EPA-453/R-07-003 |
| Large Appliance Coatings | EPA-453/R-07-004 |
| Metal Furniture Coating | EPA-453/R-07-005 |
| Miscellaneous Metal and Plastic Parts Coatings | EPA-453/R-08-003 |
| Fiberglass Boat Manufacturing Materials | EPA-453/R-08-004 |
| Miscellaneous Industrial Adhesives | EPA-453/R-08-005 |
| Automobile and Light-Duty Truck Assembly Coatings | EPA-453/R-08-006 |

### *3.2.6. Federal Consent Decrees*

- INVISTA S.à.r.l. (INVISTA) (US District Court for the District of Delaware): On April 13, 2009, INVISTA agreed to limit its emissions at the Camden, South Carolina facility such that two of its boilers will comply with a combined $NO_X$ emissions limit of 202 tons on a 12-month rolling average basis. Compliance was accomplished by converting one boiler to natural gas controlled with SCR technology and by installing a Mobotec with Rotamix design to reduce $NO_X$ emissions by 65% on an additional boiler. $SO_2$ emissions from the natural gas boiler were limited to 1 ton on a 12-month rolling average basis. INVISTA has also committed to limit sulfur content in all vaporized fuel to 1%. (INVISTA is subject to BART but refined modeling analysis conducted as part of the South Carolina Regional Haze SIP effort indicated that emissions were below the contribution threshold established.) The changes at the Camden facility were completed by December 31, 2011.

- Dupont/Lucite (US District Court for the Southern District of West Virginia): On April 20, 2009, DuPont and Lucite International Inc. agreed to pay a $2 million civil penalty to settle CAA violations at a sulfuric acid plant in Belle, West Virginia. The companies chose, on their own, to shut down the sulfuric-acid manufacturing unit, and the settlement confirms that agreement. Under the settlement the sulfuric acid unit was required to shut down by April 1, 2010. In 2002 emissions from the sulfuric acid unit included 960 tons of $SO_2$ and 52 tons of $NO_X$. The sulfuric acid unit was shut down in 2010, as required.

- Tennessee Valley Authority (Federal Facilities Compliance Agreement): On April 14, 2011, EPA announced a settlement with TVA to resolve alleged CAA violations at 11 of its coal-fired plants in Alabama, Kentucky, and Tennessee. The settlement requires TVA to invest

$3 billion to $5 billion on new and upgraded state-of-the-art pollution controls. Once fully implemented, the pollution controls and other required actions will address 92% of TVA's coal-fired power plant capacity, reducing $NO_X$ by 69% and $SO_2$ by 67% from TVA's 2008 emissions levels.

### 3.2.7. *Virginia Unit Specific Point Source Reductions*

Table 19 provides information on units that have retired or will retire, switch to cleaner fuels, or otherwise install controls and that did not have the associated 2018 emissions reductions included in the Virginia Regional Haze SIP. These units accounted for 75,378 tons and 52,140 tons of $SO_2$ emissions in 2002 and 2007, respectively. These units were projected to emit 74,233 tons of $SO_2$ in 2018 in the Virginia Regional Haze SIP.

**Table 19: Virginia Unit Specific $SO_2$ Reductions Not Included in the 2018 "Best and Final" Modeling Inventory**

| Facility Data | | | | | $SO_2$ Emissions | | |
|---|---|---|---|---|---|---|---|
| **Facility** | **ID** | **Unit(s)** | **Comment** | **Current Status** | **2002 Emissions (tpy)** | **2007 SEMAP Emissions (tpy)** | **2018 Projected Emissions (tpy)** |
| Dominion Alta Vista | 51-031-00156 | Boilers 1 and 2 | Coal units being switched to woody biomass | Biomass conversion underway | 105 | 80 | 394 |
| Dominion Hopewell | 51-670-00063 | Boilers 1 and 2 | Coal units being switched to woody biomass | Biomass conversion underway | 0 (mothballed) | 283 | 516 |
| Dominion Southampton | 51-175-00051 | Boilers 1 and 2 | Coal units being switched to woody biomass | Biomass conversion underway | 104 | 149 | 57 |
| Invista-Waynesboro | 51-820-00009 | Boilers 1, 2, and 3 | 3 coal units to be retired; replaced with 2 natural gas units | New construction under way | 1,217 | 888 | 1,213 |
| Celco | 51-071-00004 | Boilers 1, 2, 3, 4, 5, 6, and 7 | 7 coal units to be retired; replaced with 6 natural gas units | New construction under way | 6,559 | 6,500 | 6,509 |
| Potomac River Generating Station | 51-510-00003 | All | Retired December 2012 | Facility retired | 16,120 | 3,749 | 12,000 |
| Honeywell Resins and Chemicals, LLC | 51-670-00026 | Boiler #B8 | Retired 06/28/2011 | Permit requirement in permit dated 6/28/2011 | 1,491 | 933 | 1,198 |
| AEP-Clinch River | 51-167-0003 | Units 1, 2, and 3 | AEP has announced plans to gasify units 1 and 2 and retire unit 3. | Operating | 25,777 | 27,657 | 30,056 |
| AEP-Glen Lyn | 51-071-00002 | Units 51, 52, and 6 | AEP has announced plans to retire these units. | Operating | 11,541 | 1,450 | 13,423 |

| Facility Data | | | | | $SO_2$ Emissions | | |
|---|---|---|---|---|---|---|---|
| Facility | ID | Unit(s) | Comment | Current Status | 2002 Emissions (tpy) | 2007 SEMAP Emissions (tpy) | 2018 Projected Emissions (tpy) |
| Dominion-Bremo Power Station* | 51-065-0001 | Units 3 and 4 | Permit requirement for switch to natural gas* | Permit application at VDEQ for fuel switch to natural gas. | 12,464 | 10,451 | 8,867 |

* The 7/1/08 PSD permit for Dominion's Virginia City Hybrid Energy Center (Wise County) includes a condition requiring that, subject to State Corporation Commission approval, Bremo switch fuels to natural gas within two years of Virginia City commencing commercial operation. This permit was not yet issued at the time of the "best and final" modeling. Therefore, these $SO_2$ reductions were not included in the modeling exercise. Virginia City has commenced commercial operation, and the SCC has given approval for this change.

## 3.3. Summary of Emission Reductions Achieved

40 CFR 51.308(g)(2) requires "A summary of the emissions reductions achieved throughout the State through implementation of the measures in paragraph (g)(1)."

As in the original SIP submittal, this periodic update is focused on sulfates, the largest contributor to visibility impairment. Overall $SO_2$ emissions have decreased in Virginia.

### *3.3.1. EGU Reductions*

This source sector has been shown to be a major contributor to visibility impairment in the VISTAS class I areas. Very good progress has been made toward reducing $SO_2$ emissions from this sector, and additional reductions beyond those assumed in the "Best and Final" modeling are expected by 2018, further improving visibility at class I areas.

#### 3.3.1.1 EGU Reductions in Virginia

Table 20 lists all coal-fired EGU units in Virginia along with the 2002 through 2012 actual $SO_2$ emissions in tpy from each unit. This table also identifies the $SO_2$ emissions, in tpy, assigned to each unit in the "Best and Final" modeling effort for 2018. Data in this table show that actual emissions of $SO_2$ from the coal-fired EGU sector have dropped significantly in the 10 year period from 2002 and 2012. Without the inclusion of the emissions from units that did not report in 2002, emissions of $SO_2$ dropped from 216,342 tpy in 2002 to 28,345 tpy in 2012, an 87% decrease. Additionally, data in this table show that 2012 actual emissions of $SO_2$ are substantially less than predicted in the 2018 "Best and Final" modeling inventory. At the time of the development of this analysis, 2012 data was considered preliminary by the Clean Air Markets Division (CAMD) of EPA.

Figure 12 provides the annual $SO_2$ emissions from 2002 through 2012 of all Acid Rain Program coal fired units in Virginia and shows the magnitude of $SO_2$ emission reductions achieved by Virginia units during this time period. The significant reductions shown in Figure 12 resulted from several different factors. Some reductions came about due to units converting from coal to natural gas, such as Units 3 and 4 at Possum Point Power Station. Other units retired, such as Units 1 through 5 at Potomac River Generating Station, while certain units curtailed coal-fired operations, such as Units 1, 2, and 3 at Clinch River and Units 6, 51, and 52 at Glen Lyn. Lastly, some units have been retrofitted with state of the art FGD, such as Units 3, 4, 5, and 6 at Chesterfield Power Station. All these factors have significantly reduced emissions of $SO_2$ in the Commonwealth.

## Table 20: Virginia Coal Fired EGUs $SO_2$ Emissions

| Facility Name ORIS/Reg# | Unit ID# | $SO_2$ Emissions as Reported to CAMD[1] tons/year | | | | | | | | | | | 2018 B&F $SO_2$ Inventory Estimates, tons/year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012[2] | |
| Altavista Power Station 10773/30859 | 1 | 53 | 51 | 42 | 60 | 57 | 41 | 30 | 14 | 21 | --- | --- | 594 |
| | 2 | 52 | 51 | 39 | 61 | 55 | 39 | 30 | 15 | 21 | --- | --- | |
| Birchwood Power Facility 54304/40809 | 1 | Not required to report $SO_2$. | | | | | | | 1,212 | 466 | 229 | 195 | 964 |
| Bremo Power Station 3796/40119 | 3 | 4,911 | 4,437 | 3,667 | 3,378 | 3,535 | 3,485 | 2,505 | 1,445 | 2,014 | 1,048 | 604 | 2,614 |
| | 4 | 8,546 | 6,900 | 7,050 | 7,520 | 8,505 | 6,967 | 6,186 | 5,524 | 5,757 | 5,433 | 2,345 | 6,253 |
| Chesapeake Energy Center 3803/60163 | 1 | 5,866 | 4,276 | 4,965 | 4,511 | 3,957 | 3,727 | 2,603 | 2,464 | 3,564 | 2,211 | 932 | 2,765 |
| | 2 | 5,945 | 4,805 | 4,770 | 5,209 | 4,396 | 3,855 | 2,669 | 2,806 | 3,824 | 2,426 | 1,403 | 1,790 |
| | 3 | 9,558 | 8,056 | 8,992 | 8,452 | 8,531 | 4,941 | 4,435 | 4,677 | 4,823 | 4,761 | 5,133 | 2,766 |
| | 4 | 10,974 | 10,065 | 12,916 | 11,995 | 9,918 | 7,794 | 6,036 | 6,706 | 7,720 | 7,850 | 2,004 | 4,155 |
| Chesterfield Power Station 3797/50396 | 3 | 3,170 | 5,239 | 5,943 | 5,876 | 3,688 | 4,547 | 4,658 | 4,256 | 3,067 | 1,507 | 27 | 225 |
| | 4 | 9,476 | 8,995 | 10,246 | 10,663 | 7,078 | 7,620 | 8,354 | 6,959 | 6,969 | 5,723 | 101 | 744 |
| | 5 | 20,270 | 20,796 | 20,382 | 19,094 | 16,958 | 19,309 | 17,470 | 19,569 | 16,405 | 7,386 | 454 | 1,561 |
| | 6 | 40,924 | 45,447 | 26,048 | 42,744 | 37,138 | 39,616 | 7,173 | 1,500 | 1,258 | 1,266 | 641 | 3,633 |
| Clinch River 3775/10236 | 1 | 8,636 | 8,181 | 7,673 | 9,219 | 8,140 | 8,709 | 6,483 | 2,026 | 3,421 | 1,340 | 2,035 | 5,431 |
| | 2 | 9,022 | 8,208 | 7,387 | 8,895 | 9,286 | 8,801 | 7,521 | 1,149 | 2,234 | 2,281 | 1,131 | 6,494 |
| | 3 | 9,340 | 8,146 | 7,914 | 8,199 | 9,708 | 9,164 | 7,132 | 3,829 | 1,110 | 2,300 | 715 | 5,375 |
| Clover Power Station 7213/30867 | 1 | 983 | 1,033 | 1,107 | 943 | 890 | 815 | 889 | 875 | 1,223 | 958 | 871 | 691 |
| | 2 | 1,130 | 993 | 1,221 | 809 | 964 | 815 | 911 | 993 | 1,123 | 790 | 1,004 | 699 |
| Spruance Genco LLC 54081/51033 | BLR01A | Not required to report $SO_2$. | | | | | | | 112 | 124 | 104 | 49 | 358 |
| | BLR01B | | | | | | | | 111 | 123 | 111 | 53 | |
| | BLR02A | | | | | | | | 115 | 127 | 110 | 61 | 358 |
| | BLR02B | | | | | | | | 114 | 121 | 111 | 66 | |
| | BLR03A | | | | | | | | 109 | 145 | 126 | 68 | 358 |
| | BLR03B | | | | | | | | 118 | 142 | 131 | 77 | |
| | BLR04A | | | | | | | | 128 | 145 | 118 | 59 | 358 |
| | BLR04B | | | | | | | | 119 | 142 | 106 | 68 | |
| James River Cogeneration 10377/50950 | BLR01A | Not required to report $SO_2$. | | | | | | 422 | 315 | 440 | 391 | 398 | 322 |
| | BLR01B | | | | | | | 407 | 328 | 388 | 319 | 308 | |
| | BLR01C | | | | | | | 413 | 336 | 407 | 398 | 391 | |
| | BLR02A | | | | | | | 432 | 375 | 405 | 423 | 128 | 319 |
| | BLR02B | | | | | | | 404 | 340 | 354 | 336 | 153 | |
| | BLR02C | | | | | | | 414 | 327 | 379 | 299 | 133 | |
| Cogentrix-Portsmouth 10071/61049 | BLR01A | Not required to report $SO_2$. | | | | | | 492 | 125 | 301 | 124 | 29 | 107 |
| | BLR01B | | | | | | | 487 | 131 | 287 | 111 | 28 | |
| | BLR01C | | | | | | | 481 | 135 | 296 | 111 | 26 | |
| | BLR02A | | | | | | | 462 | 102 | 276 | 110 | 25 | 107 |
| | BLR02B | | | | | | | 442 | 95 | 266 | 96 | 22 | |
| | BLR02C | | | | | | | 464 | 136 | 276 | 95 | 25 | |
| Glen Lyn 3776/20460 | 51 | 7,756 | 6,832 | 6,006 | 9,368 | 9,252 | 7,548 | 7,465 | 2,888 | 1,553 | 1,486 | 534 | 1,721 |
| | 52 | 1,932 | 1,923 | 1,761 | 1,485 | 1,650 | 1,956 | 1,323 | 159 | 83 | 140 | 36 | 1,721 |
| | 6 | 1,993 | 1,907 | 1,897 | 1,550 | 1,620 | 1,987 | 1,378 | 169 | 79 | 144 | 43 | 9,981 |
| Hopewell Power Station 10771/51019 | 1 | Not required to report $SO_2$. | | | | | 163 | 30 | 8 | 27 | 10 | 7 | --- |
| | 2 | | | | | | 121 | 30 | 8 | 25 | 8 | 5 | --- |
| Mecklenburg Power Station 52007/30861 | 1 | | | 205 | 357 | 284 | 252 | 145 | 142 | 186 | 96 | 84 | 430 |
| | 2 | | | 208 | 300 | 280 | 261 | 172 | 150 | 191 | 84 | 60 | 429 |
| Possum Point Power Station 3804/70225 | 3 | 6,228 | 1,238 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | 0 |
| | 4 | 10,975 | 2,294 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | 0 |
| Potomac River Generating Station 3788/70228 | 1 | 2,150 | 2,587 | 1,849 | 2,058 | 519 | 603 | 186 | 59 | 127 | 52 | 39 | 2,400 |
| | 2 | 2,096 | 2,573 | 2,064 | 1,555 | 403 | 596 | 104 | 61 | 139 | 51 | 35 | 2,400 |
| | 3 | 4,079 | 3,066 | 2,858 | 1,648 | 655 | 688 | 422 | 284 | 397 | 137 | 179 | 2,400 |
| | 4 | 3,839 | 3,384 | 3,241 | 1,490 | 773 | 909 | 640 | 271 | 379 | 136 | 66 | 2,400 |
| | 5 | 3,978 | 3,557 | 2,940 | 1,725 | 828 | 951 | 480 | 2778 | 374 | 124 | 201 | 2,400 |

| Facility Name ORIS/Reg# | Unit ID# | $SO_2$ Emissions as Reported to CAMD[1] tons/year | | | | | | | | | | | 2018 B&F $SO_2$ Inventory Estimates, tons/year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012[2] | |
| Southampton Power Station 10774/61093 | 1 | 51 | 60 | 75 | 75 | 69 | 75 | 64 | 27 | 37 | 27 | 13 | 57 |
| | 2 | 50 | 58 | 51 | 74 | 66 | 71 | 63 | 29 | 40 | 26 | 13 | 57 |
| Yorktown Power Station 3809/60137 | 1 | 11,301 | 10,462 | 12,302 | 11,080 | 10,395 | 10,388 | 9,662 | 8,677 | 7,309 | 6,339 | 2,852 | 2,775 |
| | 2 | 11,163 | 12,651 | 12,261 | 11,636 | 10,073 | 9,226 | 10,098 | 10,315 | 8,802 | 6,848 | 4,636 | 617 |
| Virginia City Hybrid Energy Center 56808/11526 | 1 | Not in commercial operation. | | | | | | | | | | 58 | 3,292[3] |
| | 2 | | | | | | | | | | | 109 | |
| | | | | | | | | | | | Totals: | **30,732** | **82,121** |

[1]All data from EPA's CAMD database.
[2]Data from 2012 is still considered by EPA to be preliminary
[3]Permitted limits for this facility are significantly lower than 3,292 tpy of $SO_2$. At the time of the "Best and Final" modeling, the permit for the facility had not yet been finalized. 3,292 tpy of $SO_2$ represented a conservative estimate. The permitted $SO_2$ rate from the facility is 603tpy.

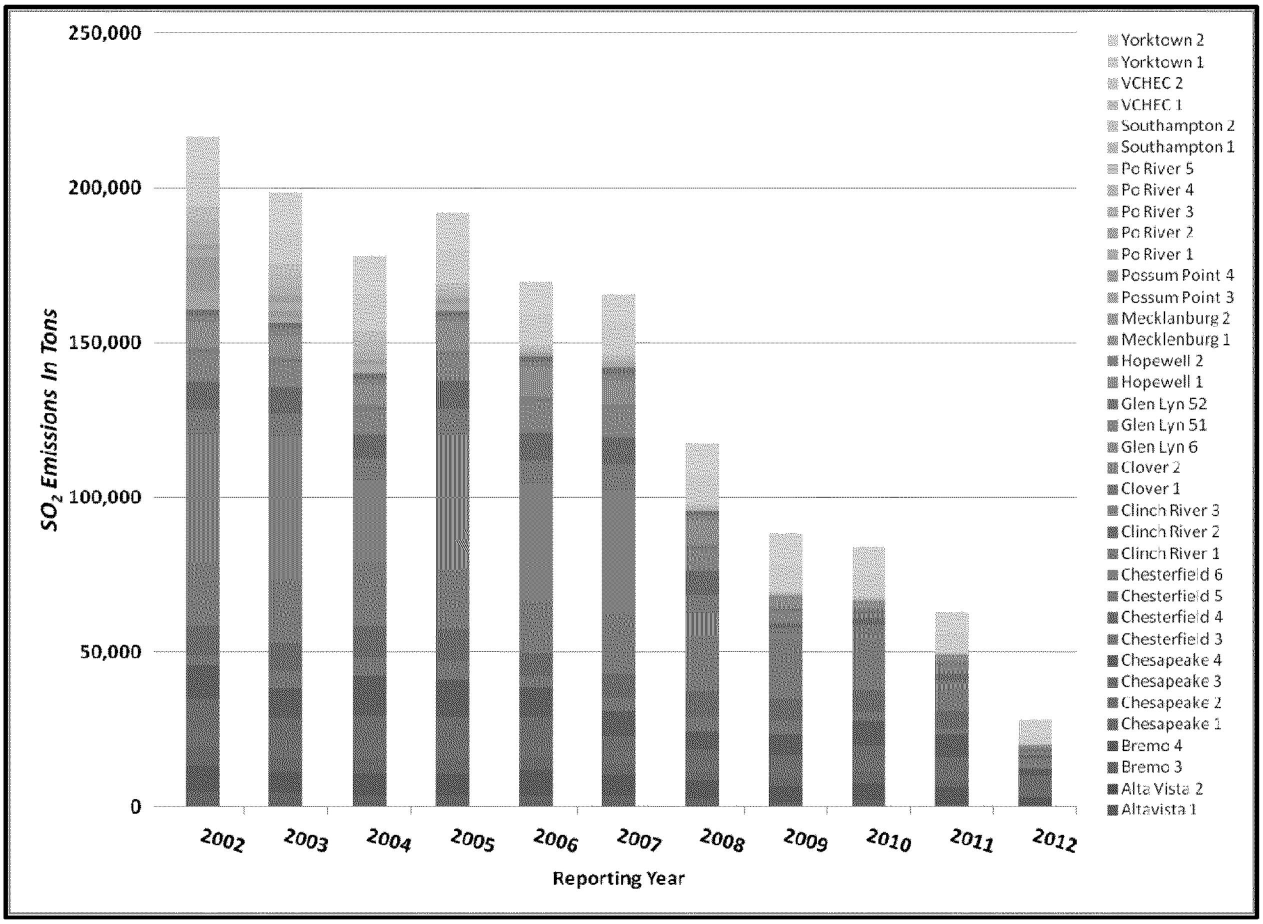


**Figure 12: Virginia Coal-Fired, Acid Rain Program Unit $SO_2$ Emissions 2002-2012**

Between 2002 and 2012, heat input to Virginia Acid Rain Program units has decreased. However, emission rates have decreased on a much greater pace, and therefore significant reductions of $SO_2$ should be maintained, even if heat inputs increase in the future. Table 21 and Figure 13 show that while heat input to all Virginia Acid Rain units has decreased approximately 27% from 2002 values, the $SO_2$ and the $NO_X$ emission rates, in terms of lb/mmbtu, have decreased 82% and 67% respectively. These reductions represent gains for the environment that should continue into the future, regardless of the fluctuations in heat input supplied to these units in the coming years. This is generally true for EGUs in Virginia and across the VISTAS states.

**Table 21: Virginia Acid Rain Program Unit Data, 2002-2012[1]**

| Reporting Year | $SO_2$ tpy | $SO_2$ lb/mmbtu | $NO_X$ tpy | $NO_X$ lb/mmbtu | Heat Input mmbtu/year |
|---|---|---|---|---|---|
| 2002 | 230,846 | 1.151 | 78,868 | 0.393 | 401,232,256 |
| 2003 | 215,740 | 1.091 | 69,077 | 0.349 | 395,662,469 |
| 2004 | 196,504 | 0.988 | 60,405 | 0.304 | 397,612,735 |
| 2005 | 207,748 | 1.036 | 57,863 | 0.289 | 400,903,337 |
| 2006 | 171,943 | 0.978 | 49,821 | 0.283 | 351,787,999 |
| 2007 | 172,685 | 0.863 | 53,488 | 0.267 | 400,078,261 |
| 2008 | 125,985 | 0.695 | 43,017 | 0.237 | 362,431,406 |
| 2009 | 93,163 | 0.573 | 25,881 | 0.159 | 324,931,355 |
| 2010 | 91,775 | 0.502 | 33,085 | 0.181 | 365,853,728 |
| 2011 | 66,885 | 0.442 | 29,185 | 0.193 | 302,516,447 |
| 2012 | 30,772 | 0.210 | 19,000 | 0.130 | 292,432,620 |

[1]2012 data is still considered preliminary by EPA.

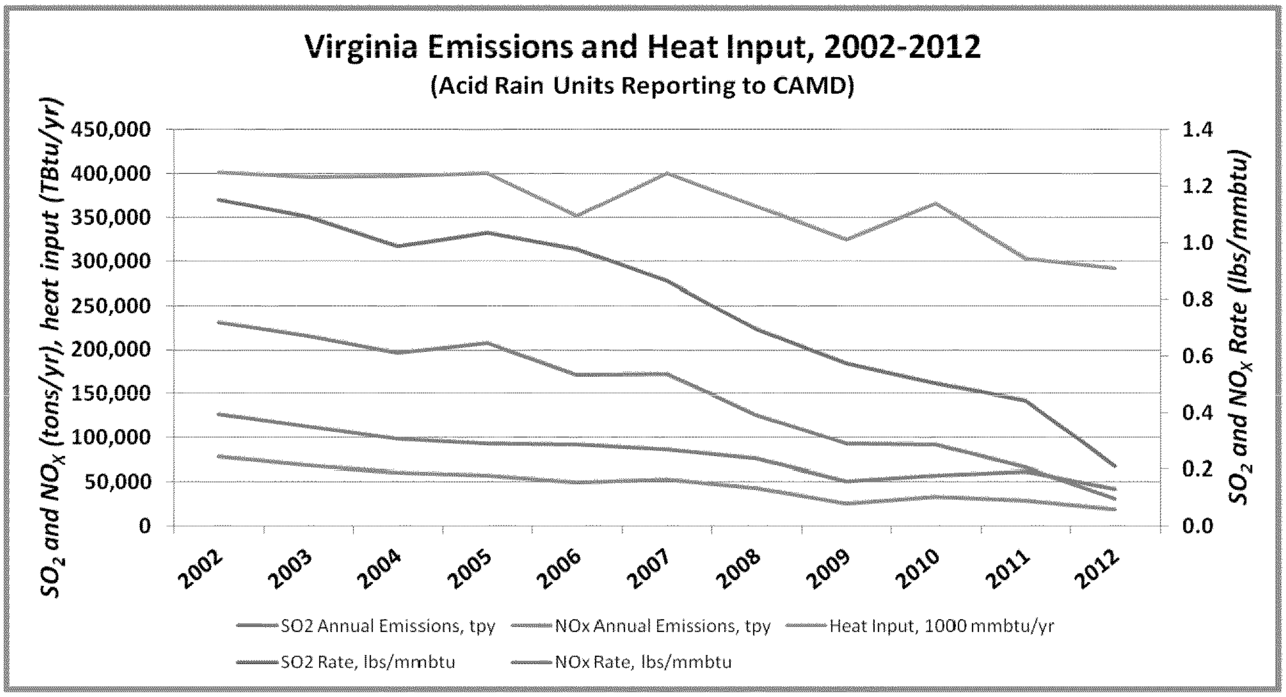


**Figure 13: Virginia Acid Rain Program Data**

### 3.3.1.2 EGU Reductions Outside of Virginia

All states in VISTAS have seen tremendous progress toward reducing emissions between 2002 and 2012. Table 22 summarizes the emissions and emissions rates as well as heat input for years



Freedom_0006145_0057

2002 through 2012 for all Acid Rain program units in VISTAS states, as reported to CAMD. Figure 14 shows this information graphically. Across VISTAS, 2012 heat input decreased only 8% from 2002 values, while $SO_2$ and $NO_X$ emission rates declined 76% and 73% respectively.

**Table 22: VISTAS Acid Rain Units**

| Reporting Year | $SO_2$ tpy | $SO_2$ lb/mmbtu | $NO_X$ tpy | $NO_X$ lb/mmbtu | Heat Input mmbtu/year |
|---|---|---|---|---|---|
| 2002 | 3,713,262 | 0.971 | 1,498,143 | 0.392 | 7,645,295,464 |
| 2003 | 3,846,147 | 1.019 | 1,360,446 | 0.360 | 7,549,812,091 |
| 2004 | 3,635,738 | 0.957 | 1,195,489 | 0.315 | 7,601,245,546 |
| 2005 | 3,725,196 | 0.944 | 1,142,986 | 0.290 | 7,893,946,365 |
| 2006 | 3,489,194 | 0.881 | 1,104,534 | 0.279 | 7,921,126,852 |
| 2007 | 3,175,353 | 0.773 | 1,050,108 | 0.256 | 8,217,954,443 |
| 2008 | 2,565,907 | 0.655 | 895,198 | 0.229 | 7,833,760,033 |
| 2009 | 1,619,348 | 0.465 | 454,044 | 0.130 | 6,966,765,915 |
| 2010 | 1,415,331 | 0.365 | 510,309 | 0.132 | 7,760,905,869 |
| 2011 | 1,166,588 | 0.318 | 462,144 | 0.126 | 7,336,214,497 |
| 2012[1] | 811,059 | 0.231 | 368,296 | 0.105 | 7,033,265,310 |

[1]*Preliminary 2012 CAMD data.*

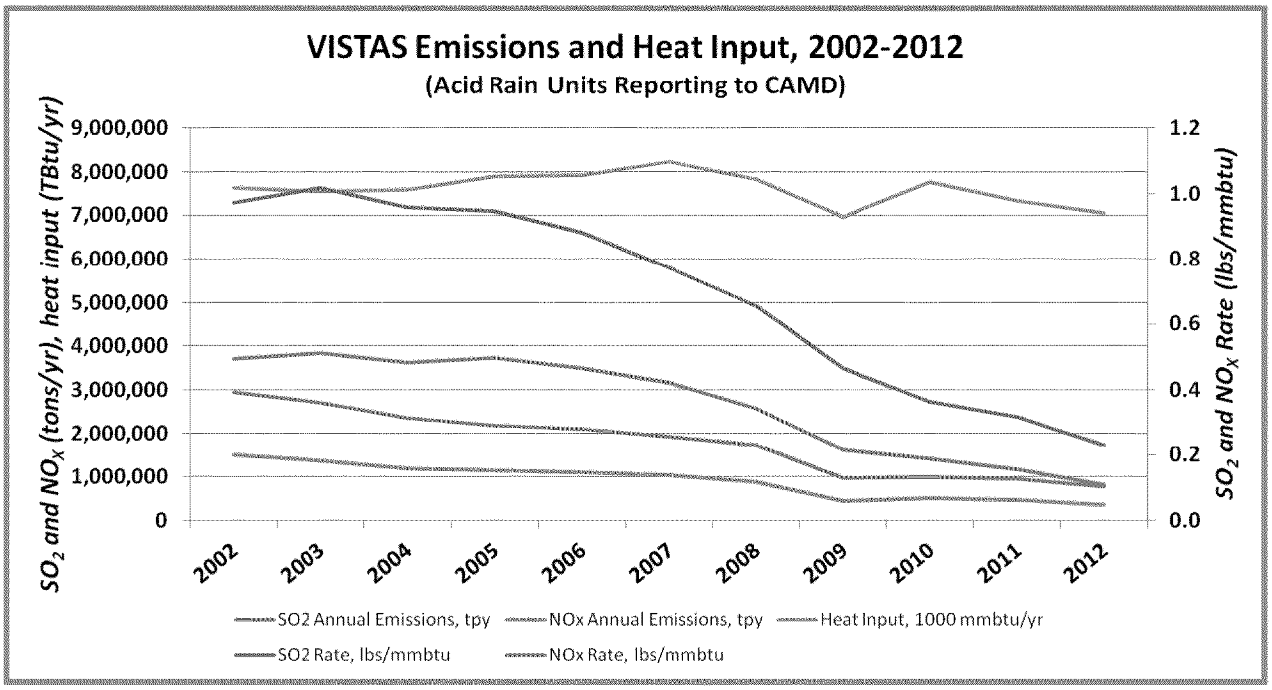


**Figure 14: VISTAS States' Acid Rain Program Data**

Table 23 lists the EGUs located outside of Virginia that have a calculated sulfate contribution to visibility impairment at Virginia class I areas of at least 0.5%. This table provides the 2002 emissions data as well as the 2007 and 2012 emissions data for these units. The table shows significant reductions from these units between 2002 and 2012 due to the installation of controls and unit retirements.

**Table 23: EGUs Outside of Virginia with a Calculated 0.5% Impact on Virginia Class I Areas**

| Facility (State) | ORIS ID | Unit | Current $SO_2$ Controls | 2002 $SO_2$ Emissions (tons) | 2007 $SO_2$ Emissions (tons) | 2012[1] $SO_2$ Emissions (tons) |
|---|---|---|---|---|---|---|
| ***EGUs with at least a 0.5% calculated contribution to James River Face*** | | | | | | |
| John E. Amos Plant (WV) | 3935 | 003 | Scrubber installed 2008 | 39,570 | 44,612 | 1,539 |
| Duke-Dan River (NC) | 2723 | 1 | Retired 4/1/2012. | 2,637 | 1,688 | --- |
| John E. Amos Plant (WV) | 3935 | 002 | Scrubber installed 2009 | 27,651 | 30,963 | 678 |
| John E. Amos Plant (WV) | 3935 | 001 | Scrubber installed 2009 | 30,015 | 27,971 | 916 |
| AEP-Mountaineer (WV) | 6264 | 001 | Scrubber installed 2007 | 39,064 | 2,302 | 1,151 |
| Duke-Belews Creek (NC) | 8042 | 1 | Scrubber installed 2008 | 43,789 | 38,356 | 2,200 |
| Duke-Belews Creek (NC) | 8042 | 2 | Scrubber installed 2008 | 39,678 | 48,032 | 1,875 |
| Duke-Dan River (NC) | 2723 | 3 | Retired 4/1/2012. | 1,040 | 3,944 | --- |
| Monongahela Power-Harrison (WV) | 3944 | 003 | Scrubber installed 1994 | 2,582 | 1,705 | 4,867 |
| Monongahela Power-Harrison (WV) | 3944 | 002 | Scrubber installed 1994 | 2,731 | 1,164 | 3,195 |
| Monongahela Power-Harrison (WV) | 3944 | 001 | Scrubber installed 1994 | 3,355 | 1,868 | 3,986 |
| Big Sandy (KY) | 1353 | 002 | | 36,036 | 36,114 | 13,920 |
| Duke-Dan River (NC) | 2723 | 2 | Retired 4/1/2012. | 938 | 2,040 | --- |
| | | | ***Totals:*** | ***269,068*** | ***240,759*** | ***34,327*** |
| ***EGUs with at least a 0.5% calculated contribution to Shenandoah*** | | | | | | |
| Mirant-Morgantown(MD) | 1571 | 1 | Scrubbers installed 2010 | 37,757 | 22,879 | 2,510 |
| Mirant-Morgantown (MD) | 1571 | 2 | Scrubbers installed 2010 | 32,587 | 21,907 | 2,045 |
| Mount Storm (WV) | 3954 | 001 | Scrubber installed 2002 | 8,817 | 836 | 2,319 |
| Mount Storm (WV) | 3954 | 002 | Scrubber installed 2001 | 9,572 | 866 | 2,297 |
| Mount Storm (WV) | 3954 | 003 | Scrubber installed 1994 | 2,779 | 1,071 | 833 |
| Monongahela-Harrison (WV) | 3944 | 003 | Scrubber installed 1994 | 2,582 | 1,705 | 4,867 |
| Monongahela-Harrison (WV) | 3944 | 002 | Scrubber installed 1994 | 2,731 | 1,164 | 3,195 |
| Monongahela-Harrison (WV) | 3944 | 001 | Scrubber installed 1994 | 3,355 | 1,868 | 3,986 |
| Indian River (DE) | 594 | 004 | Scrubber installed 2012 | 7,504 | 5,957 | 692 |
| Mountaineer (WV) | 6264 | 001 | Scrubber installed 2007 | 39,064 | 2,302 | 1,151 |
| John Amos (WV) | 3935 | 003 | Scrubber installed 2008 | 39,570 | 27,971 | 916 |
| Monongahela-Fort Martin (WV) | 3943 | 001 | Scrubber installed 2010 | 46,852 | 42,274 | 2,232 |
| Monongahela-Fort Martin (WV) | 3943 | 002 | Scrubber installed 2010 | 42,467 | 45,757 | 1,190 |
| Constellation-Brandon Shores(MD) | 602 | 1 | Scrubber installed 2010. | 20,476 | 17,323 | 1,547 |
| | | | ***Totals:*** | ***296,113*** | ***193,880*** | ***29,780*** |

[1]*Preliminary 2012 CAMD data.*

### *3.3.2. Additional $SO_2$ EGU Emission Reductions*

Several data sources indicate that the coal-fired electrical generating sector will continue undergoing changes benefitting the environment between now and 2018. Integrated Resource Plan (IRP) documents are one such data source. The Virginia State Corporation Commission (SCC) requires the submittal of an annual IRP for utilities operating within the Commonwealth. The IRP is a mandatory 15-year, forward-looking plan for matching generation, transmission, and demand side management resources with expected electricity demand. Information in the IRP is not a commitment to build any particular project or retire any particular unit but represents the company's evaluation of plans to meet the expected needs of its customers in a cost-effective manner over the next 15 years. Dominion filed its annual IRP with the SCC on August 31, 2012. This document notes that current plans call for the retirement of all four coal-fired units at the Chesapeake Energy Center as well as the retirement of Units 1 and 2 at the Yorktown Power Station in the 2015 timeframe. Dominion's IRP is available at https://www.dom.com/about/integrated-resource-planning.jsp .

Reports from PJM, the regional transmission organization coordinating the movement of wholesale electricity in the mid-Atlantic states, is another such data source. PJM provides status updates on pending deactivation and fuel switching requests on its website, the latest of which may be found at http://pjm.com/~/media/planning/gen-retire/pending-deactivation- requests.ashx. This document indicates that all three units at Glen Lyn Generating Station will retire. It also indicates that Unit 3 at Clinch River Generating Station will be retired. These retirements are scheduled to take place prior to 2018. Additionally, the owners of Clinch River Generating Station, American Electric Power, have informed VDEQ that they intend to convert Units 1 and 2 at Clinch River to natural gas by 2018. This information was corroborated in correspondence dated May 3, 2013 from American Electric Power to VDEQ, requesting an extension of the MATS compliance date.

Should these changes be implemented, Virginia will have no coal-fired EGUs that are uncontrolled for $SO_2$ by 2018, greatly reducing the impact any of these units might have on visibility in the Commonwealth's class I areas.

Table 24 lists all coal-fired EGU units in Virginia and shows the controls assigned to the units in 2018 as part of the "Best and Final" modeling effort. Table 24 also provides the current status of those control assignments and any new information that has become available about these units. This table shows that the current energy markets and the regulatory environment are pushing further environmentally beneficial changes in the forms of retirements, curtailments, and fuel conversions.

## Table 24: Virginia Coal-fired EGUs

| Facility Name ORIS/Reg# | Unit ID# | Size | | NSR Permit? | 2007 Assumptions used in Virginia's Regional Haze SIP | | | | | | | | 2013 Update |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Existing Control Equipment and Emission Reduction Strategies | | | | | | Projected Control or Strategy | Projected Year to Install | |
| | | MW | mmbtu /hr | | PM | Year Installed | $NO_X$ | Year Installed | $SO_2$ | Year Installed | | | |
| Altavista Power Station 10773/30859 | 1 | 71.1 | 383 | Yes | FF | At start up | LNB, SNCR | At start up | SDA 92% CE | At start up | n/a | n/a | Units are converting to woody biomass. |
| | 2 | 71.1 | 383 | Yes | FF | At start up | LNB, SNCR | At start up | SDA 92% CE | At start up | n/a | n/a | |
| Birchwood Power Facility 54304/40809 | 1 | 220 | 2,300 | Yes | FF | At start up | SCR | At start up | DLS 94% CE | At start up | n/a | n/a | |
| Bremo Power Station 3796/40119 | 3 | 69 | 912 | No | ESP(hot sided) | --- | BOOS | 2004 | None | --- | None | None | Units are switching fuels to natural gas. |
| | 4 | 185 | 1,699 | No | ESP(hot sided) | --- | LNB, ROFA | 2004 | None | --- | None | None | |
| Chesapeake Energy Center 3803/60163 | 1 | 113 | 1,300 | No | ESP | --- | ROFA, SNCR | 2003 | Low S coal[4] | 2007 | n/a | n/a | Facility uses low sulfur coal. Most recent IRP filed with the SCC indicates units will be retired by 2018. |
| | 2 | 113 | 1,300 | No | ESP | --- | ROFA, SNCR | 2003 | Low S coal[4] | 2007 | n/a | n/a | |
| | 3 | 185 | 1,663 | No | ESP | --- | LNB SCR | 2003 | Low S coal[4] | 2007 | n/a | n/a | |
| | 4 | 239 | 2,346 | No | ESP | --- | LNB SCR | 2003 | Low S coal[4] | 2007 | n/a | n/a | |
| Chesterfield Power Station 3797/50396 | 3 | 113 | 1,155 | No | ESP | --- | LNB OFA | 2003 | None | 2012 | FGD 90% CE[5] | 2012 | Controls installed and operational. |
| | 4 | 188 | 1,761 | No | ESP | --- | Staged comb SCR | 2003 | None | 2011 | FGD 90% CE[5] | 2011 | |
| | 5 | 359 | 3.604 | No | ESP | --- | Staged comb SCR | 2002 | None | 2010 | FGD 90% CE[5] | 2011 | |
| | 6 | 694 | 6,650 | No | ESP | --- | Staged comb SCR | 2004 | FGD 90% CE + polishing baghouse | 2008 | n/a | n/a | |
| Clinch River 3775/10236 | 1 | 238 | 2,100 | No | ESP | --- | Staged Comb LNB SNCR | 2004 2007 2009 | None | --- | $SO_2$ Cap | | Current plans include gasifying these units. |
| | 2 | 238 | 2,100 | No | ESP | --- | Staged Comb LNB SNCR | 2004 2007 2009 | None | --- | $SO_2$ Cap | | |
| Clinch River 3775/10236 | 3 | 238 | 2,100 | No | ESP | --- | Staged Comb LNB SNCR | 2002 2007 2009 | None | --- | $SO_2$ Cap | | Current plans include retiring this unit. |

| Facility Name ORIS/Reg# | Unit ID# | Size | | NSR Permit? | 2007 Assumptions used in Virginia's Regional Haze SIP | | | | | | | | 2013 Update |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Existing Control Equipment and Emission Reduction Strategies | | | | | | Projected Control or Strategy | Projected Year to Install | |
| | | MW | mmbtu/hr | | PM | Year Installed | $NO_X$ | Year Installed | $SO_2$ | Year Installed | | | |
| Clover Power Station 7213/30867 | 1 | 424 | 4,085 | Yes | FF | At start up | LNB/ OFA/ SNCR | LNB & OFA at start up; SNCR 2003 | Wet FGD 94% CE | At startup | n/a | n/a | |
| | 2 | 424 | 4,085 | Yes | FF | At start up | LNB/ OFA/ SNCR | LNB & OFA at start up; SNCR 2003 | Wet FGD 94% CE | At startup | n/a | n/a | |
| Spruance Genco LLC 54081/51033 | BLR01A | 115 | 375 | Yes | FF | At start up | OFA/FGR SNCR/ Meth | At startup | SDA 92% CE | At startup | n/a | n/a | |
| | BLR01B | | 375 | Yes | FF | At start up | OFA/FGR SNCR/ Meth | At startup | SDA 92% CE | At startup | n/a | n/a | |
| | BLR02A | 115 | 375 | Yes | FF | At start up | OFA/FGR SNCR/ Meth | At startup | SDA 92% CE | At startup | n/a | n/a | |
| | BLR02B | | 375 | Yes | FF | At start up | OFA/FGR SNCR/ Meth | At startup | SDA 92% CE | At startup | n/a | n/a | |
| | BLR03A | 115 | 375 | Yes | FF | At start up | OFA/FGR SNCR/ Meth | At startup | SDA 92% CE | At startup | n/a | n/a | |
| | BLR03B | | 375 | Yes | FF | At start up | OFA/FGR SNCR/ Meth | At startup | SDA 92% CE | At startup | n/a | n/a | |
| | BLR04A | 115 | 375 | Yes | FF | At start up | OFA/FGR SNCR/ Meth | At startup | SDA 92% CE | At startup | n/a | n/a | |
| | BLR04B | | 375 | Yes | FF | At start up | OFA/FGR SNCR/ Meth | At startup | SDA 92% CE | At startup | n/a | n/a | |
| James River Cogeneration 10377/50950 | BLR01A | 108.5 | 200 | Yes | FF | At start up | OFA/FGR | 2004 | FGD 90% CE | 2008 | n/a | n/a | |
| | BLR01B | | 200 | Yes | FF | At start up | OFA/FGR | 2004 | FGD 90% CE | 2008 | n/a | n/a | |
| | BLR01C | | 200 | Yes | FF | At start up | OFA/FGR | 2004 | FGD 90% CE | 2008 | n/a | n/a | |
| | BLR02A | 108.5 | 200 | Yes | FF | At start up | OFA/FGR | 2004 | FGD 90% CE | 2008 | n/a | n/a | |
| | BLR02B | | 200 | Yes | FF | At start up | OFA/FGR | 2004 | FGD 90% CE | 2008 | n/a | n/a | |

| Facility Name ORIS/Reg# | Unit ID# | Size | | NSR Permit? | 2007 Assumptions used in Virginia's Regional Haze SIP | | | | | | | | 2013 Update |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Existing Control Equipment and Emission Reduction Strategies | | | | | | Projected Control or Strategy | Projected Year to Install | |
| | | MW | mmbtu /hr | | PM | Year Installed | $NO_X$ | Year Installed | $SO_2$ | Year Installed | | | |
| | BLR02C | | 200 | Yes | FF | At start up | OFA/FGR | 2004 | FGD 90% CE | 2008 | n/a | n/a | |
| Cogentrix-Portsmouth 10071/61049 | BLR01A | 108.5 | 200 | Yes | FF | At start up | OFA/FGR | 2004 | FGD 90% CE | 2007 | n/a | n/a | |
| | BLR01B | | 200 | Yes | FF | At start up | OFA/FGR | 2004 | FGD 90% CE | 2007 | n/a | n/a | |
| | BLR01C | | 200 | Yes | FF | At start up | OFA/FGR | 2004 | FGD 90% CE | 2007 | n/a | n/a | |
| | BLR02A | 108.5 | 200 | Yes | FF | At start up | OFA/FGR | 2004 | FGD 90% CE | 2007 | n/a | n/a | |
| | BLR02B | | 200 | Yes | FF | At start up | OFA/FGR | 2004 | FGD 90% CE | 2007 | n/a | n/a | |
| | BLR02C | | 200 | Yes | FF | At start up | OFA/FGR | 2004 | FGD 90% CE | 2007 | n/a | n/a | |
| Glen Lyn 3776/20460 | 51 | 100 | 572 | No | ESP | --- | Staged Comb LNB | 2004<br>2007 | None | --- | n/a | n/a | Facility has announced plans to retire these units by 2017. |
| | 52 | 100 | 572 | No | ESP | --- | Staged Comb LNB | 2004<br>2007 | None | --- | n/a | n/a | |
| | 6 | 238 | 2,040 | No | ESP | --- | Staged Comb LNB | 2004<br>2007 | None | --- | n/a | n/a | |
| Hopewell Power Station 10771/51019 | 1 | 71.1 | 391 | Yes | FF | At start up | OFA/ SNCR | At startup | SDA 92% CE | At startup | n/a | n/a | Facility is converting to woody biomass. |
| | 2 | 71.1 | 391 | Yes | FF | At start up | OFA/ SNCR | At startup | SDA 92% CE | At startup | n/a | n/a | |
| Mecklenburg Power Station 52007/30861 | 1 | 69.9 | 834 | Yes | FF | At startup | OFA | At startup | SDA 92% CE | At startup | n/a | n/a | |
| | 2 | 69.9 | 834 | Yes | FF | At start up | OFA | At startup | SDA 92% CE | At startup | n/a | n/a | |
| Potomac River Generating Station 3788/70228 | 1 | 93 | 970 | No | ESP | --- | LNB | 2005 | Sorbent Inj | 2006 | None | None | Facility retired at the end of 2012. |
| | 2 | 93 | 970 | No | ESP | --- | LNB | 2005 | Sorbent Inj | 2006 | None | None | |
| | 3 | 108 | 961 | No | ESP | --- | LNB/ SOFA | 2004 | Sorbent Inj | 2006 | None | None | |
| | 4 | 108 | 961 | No | ESP | --- | LNB/ SOFA | 2004 | Sorbent Inj | 2006 | None | None | |
| | 5 | 108 | 961 | No | ESP | --- | LNB/ SOFA | 2004 | Sorbent Inj | 2006 | None | None | |

| Facility Name ORIS/Reg# | Unit ID# | Size | | NSR Permit? | 2007 Assumptions used in Virginia's Regional Haze SIP | | | | | | | | 2013 Update |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Existing Control Equipment and Emission Reduction Strategies | | | | | | Projected Control or Strategy | Projected Year to Install | |
| | | MW | mmbtu/hr | | PM | Year Installed | $NO_X$ | Year Installed | $SO_2$ | Year Installed | | | |
| Southampton Power Station 10774/61093 | 1 | 71.1 | 400 | Yes | FF | At start up | Staged Comb/ OFA | At start up | SDA 92% CE | At start up | n/a | n/a | Facility is converting to woody biomass. |
| | 2 | 71.1 | 400 | Yes | FF | At start up | Staged Comb/ OFA | At start up | SDA 92% CE | At start up | n/a | n/a | |
| Yorktown Power Station 3809/60137 | 1 | 173 | 1,697 | No | ESP | --- | ROFA/ SNCR | 2004 | None | --- | FGD 90% CE | 2010 | Most current IRP indicates that these units may retire or switch fuels to natural gas. |
| | 2 | 182 | 1,745 | No | ESP | --- | ROFA/ SNCR | 2004 | None | --- | FGD 90% CE | 2018 | |
| Virginia City Hybrid Energy Center 56808/11526 | 1 | 330 | | Yes | FF | At start up | SNCR | At start up | Limestone Injection & DLS | At start up | n/a | n/a | Values modeled for $SO_2$ were estimated permit limits of more than 3,000 tpy of $SO_2$. Final permit limits emissions to 603.6 tpy $SO_2$. |
| | 2 | 330 | | Yes | FF | At start up | SNCR | At start up | Limestone Injection & DLS | At start up | n/a | n/a | |

### 3.3.3. *EGU $SO_2$ Inventory Data Analysis*

Figure 15 compares the EGU $SO_2$ emissions estimates contained in a variety of different inventories. The VISTAS 2002 actual inventory and 2002 typical inventory, as well as the VISTAS 2009 and 2018 Base G4 projections, include the $SO_2$ emissions for the entire EGU facility. In comparison, the CAMD emissions include only the Acid Rain Program EGU unit $SO_2$ emissions as reported to CAMD. The EGU unit emissions are the preponderance of the emissions at these facilities. The actual 2002 VISTAS inventory reflects the base year emissions that correspond to the meteorological data used in the modeling effort, in that case, 2002. These emissions were used for evaluating air quality model performance. The 2002 typical VISTAS inventory is similar to the actual base year. However, for sources that may have significant emissions changes from year to year, the inventory assumed a more typical emission value. Typical emissions for 2002 were developed for the EGU and wildfire sectors. Virginia's 2009 EGU $SO_2$ emissions, as reported to CAMD, are well below the modeled values that were included in the 2009 Base G4 projection inventory. CAMD data for Virginia Acid Rain Program units have reported emissions less than the 2018 Base G4 modeling projections for 2009, 2010, 2011, and 2012. Table 20 provides the unit level $SO_2$ emissions data as reported to CAMD for all Virginia coal-fired units.

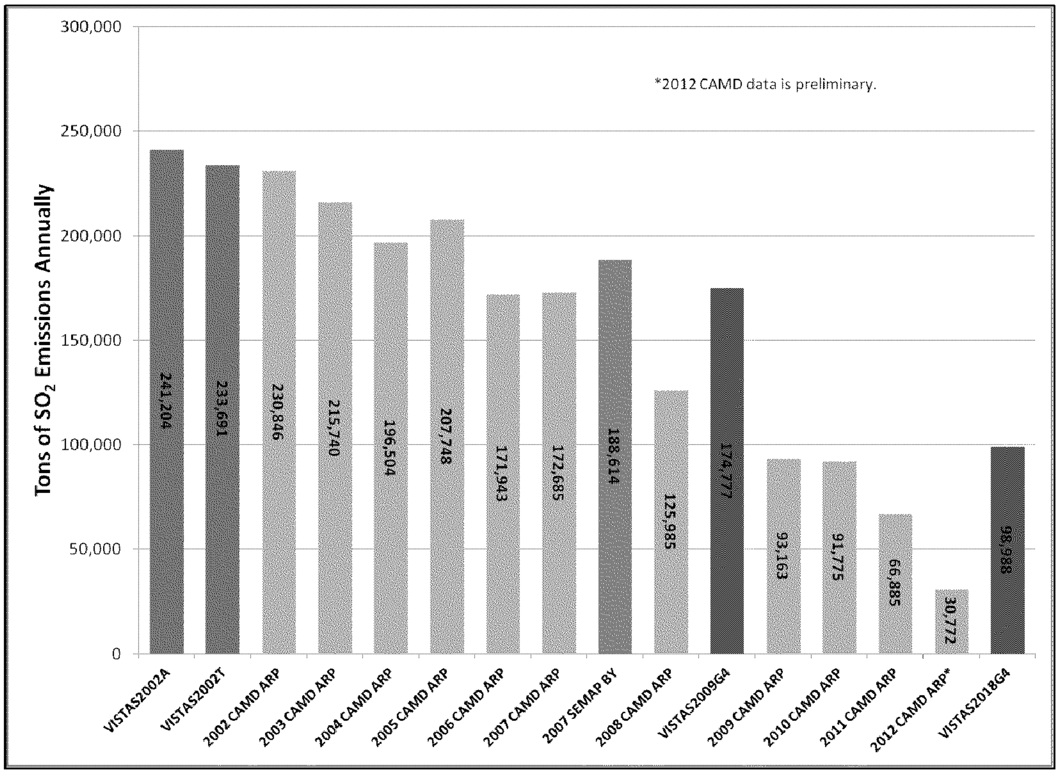


**Figure 15: Virginia EGU $SO_2$ Inventory Data Comparison**

### 3.3.4. *MANE-VU "Ask"*

During the development of the Virginia Regional Haze SIP, the Mid-Atlantic/Northeast Visibility Union (MANE-VU) states of New Jersey and New Hampshire sent letters to Virginia in the spring of 2007 stating that based on 2002 emission estimates, Virginia contributed to class

I visibility impairment in those states. The MANE-VU states identified 167 EGU stacks as contributing significantly to visibility impairment at MANE-VU class I areas in 2002. MANE-VU asked states to reduce the $SO_2$ emissions from these units by 90% (EGU Ask). MANE-VU also requested a control strategy to provide a 28% reduction in $SO_2$ emissions from sources, other than EGUs, that would be equivalent to their estimated reductions from a proposed low sulfur residential fuel oil strategy (Non-EGU Ask).

#### 3.3.4.1 MANE-VU "EGU Ask"

The MANE-VU states identified 167 stacks, 8 of which are located in Virginia. These 8 stacks identified by MANE-VU vent the emissions from 10 EGUs. The Virginia stacks, units, and emissions are identified in Table 25. MANE-VU has asked states to reduce the $SO_2$ emissions from these units by 90%. Many of the units and stacks listed in Table 25 will have reduced emissions by 90% or more in 2018. In fact, Table 25 demonstrates that 2012 emissions from these units are 86.2% less than those reported in 2002, based on CAMD's preliminary 2012 data. These units are expected to further reduce emissions as plans for retirements and fuel switches come to fruition. The information in Table 25 is based on federal consent decrees, knowledge of owner control program installation timelines, data supplied to the SCC in IRPs, data supplied to VDEQ by facility owners, and IPM projections. Therefore, the request made by MANE-VU within their "EGU Ask" has been substantially satisfied by Virginia.

**Table 25: Virginia EGUs Identified by MANE-VU**

| Plant | ORIS ID/ Inventory ID | Unit | MW | 2002 $SO_2$ Emissions (tons) | $SO_2$ controls | Control Installation Date | $SO_2$ Control Efficiency | 2012[1] CAMD Data | 2018 Projected $SO_2$ Emissions for Regional Haze SIP (tons) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| Dominion – Chesapeake Power Station | 3803<br>51-550-00026 | 3 | 185 | 9,233 | Low S coal | 2007 | 40% | 5,133 | 2,766 | IPM predicts these units will be controlled by scrubbers in 2018. The Dominion IRP suggests that these units will be retired. |
| | | 4 | 239 | 12,505 | Low S coal | 2007 | 40% | 2,004 | 4,155 | |
| Dominion – Chesterfield Power Station | 3797<br>51-041-0002 | 4 | 188 | 9,416 | FGD | 2010 | 90% | 101 | 744 | These control devices are achieving significantly better control efficiencies than those assumed in the Regional Haze SIP modeling. |
| | | 5 | 359 | 19,129 | FGD | 2010 | 90% | 454 | 1,561 | |
| | | 6 | 694 | 38,088 | FGD | 2008 | 95% | 641 | 3,633 | |
| AEP – Clinch River | 3775<br>51-167-00003 | 1 | 238 | 8,158 | Low S coal | --- | --- | 2,035 | 5,430 | Based on federal consent decree, the facility (units 1, 2, and 3) has a cap of 16,300 tpy beginning in 2015. Additionally, AEP has informed VDEQ that they intend to switch these units to natural gas. |
| | | 2 | 238 | 8,115 | Low S coal | --- | --- | 1,131 | 5,494 | |
| Dominion – Yorktown Power Station | 3809<br>51-199-00001 | 1 | 173 | 11,551 | FGD | 2010 | 90% | 2,852 | 652 | Dominion's IRP suggests that these units will be retired. |
| | | 2 | 182 | 12,426 | FGD | 2018 | 90% | 4,636 | 617 | |
| | | 3 | 875 | 11,498 | Predicted by IPM to shutdown in 2018 | | | 408 | --- | Oil fired boiler. |
| *ESTIMATED EMISSIONS TOTAL:* | | | | 140,119 | | | | 19,395 | 25, 052 | The VA Regional Haze SIP estimated $SO_2$ reductions from these units to be 82% in 2018, as compared to 2002 estimates. Actual 2012 data show that these units emitted 86% less than 2002 estimates. More reductions are expected by 2018. |

(1)Preliminary 2012 CAMD data

3.3.4.2 MANE-VU "Non-EGU Ask"

MANE-VU requested a control strategy to provide a 28% reduction in $SO_2$ emissions from sources, other than EGUs, that would be equivalent to their proposed low sulfur residential fuel oil strategy.

Virginia's non-EGUs were predicted to emit 57,790 tons of $SO_2$ in 2018. MANE-VU requested a 28% reduction in these emissions, or approximately 16,181 tpy of reductions. Two EGUs in Virginia not on the MANE-VU listing of 167 stacks already have in place enforceable conditions that, while not originally intended for this purpose, should facilitate the bulk of the requested reductions. Dominion Bremo Power Station (ORIS 3796) and Potomac River Generating Station (ORIS 3788) have requirements limiting their $SO_2$ emissions in 2018, and these emission reductions were not included in the reasonable progress modeling exercise. These requirements came into place after the reasonable progress goal modeling was performed.

Bremo Power Station is scheduled to convert to a cleaner fuel two years after the commencement of commercial operation of the Virginia City Hybrid Energy Center. This conversion is a requirement in their July 1, 2008 prevention of significant deterioration (PSD) permit. The Energy Center began commercial operation in 2012, so the fuel switch at Bremo should take place in 2014, well before MANE-VU's requested 2018 deadline. Bremo Power Station emitted approximately 12,000 tons of $SO_2$ in 2002 and was expected, prior to the permit requirement for the fuel switch, to emit over 8,800 tons of $SO_2$ in 2018. The switch to a fuel with little or no sulfur would eliminate nearly all these emissions.

On December 12, 2012, the Potomac River Generating Station was permanently shut down. In 2002, this facility emitted over 15,000 tons of $SO_2$, and the facility was expected to emit 12,000 tons of $SO_2$ in 2018. This retirement represents a 12,000 tpy reduction in 2018 $SO_2$ emissions.

Other $SO_2$ reductions in the non-EGU category are also going to take place before 2018. Invista (51-820-0009) owns and operates a synthetic fiber production facility located in Waynesboro, Virginia. The facility has a powerhouse consisting of three boilers that predominantly use coal, with a total heat input of approximately 600 mmbtu/hr. Table 26 provides emissions information on the existing powerhouse for the facility.

**Table 26: Invista Powerhouse Emissions 2007-2011, SO2 and NOx**

| Year | Tons $NO_X$/Year | Tons $SO_2$/Year |
|---|---|---|
| 2011 | 184.0 | 567.8 |
| 2010 | 198.5 | 629.1 |
| 2009 | 237.7 | 768.1 |
| 2008 | 275.7 | 843.2 |
| 2007 | 353.2 | 924.2 |

Data Source: VDEQ-CEDS

In the 2018 future year emission estimates used to develop the reasonable progress goals, this facility's powerhouse accounted for an estimated 1,214 tpy of $SO_2$. The facility received a federally enforceable permit from VDEQ to retire the existing boilers and in their place install two new, natural gas-fired boilers that use distillate oil and liquefied petroleum gas as back-up fuels. These new units are permitted at 33.8 tpy $NO_X$ and 2.3 tpy $SO_2$. This change would reduce the $NO_X$ emissions by more than 100 tpy and the $SO_2$ emissions by more than 500 tpy, as compared to 2011 values. The facility commenced construction on these boilers in December 2012.

Celanese Acetate, LLC (Celco) (51-071-0004) is a large manufacturing facility located in Giles County, Virginia. The facility primarily manufactures cellulose acetate flake and fiber using wood pulp and acetic acid as raw materials. To facilitate operations, the facility has a steam plant consisting of seven coal-fired boilers and two natural gas-fired boilers. The seven coal-fired boilers have a capacity of approximately 1,400 mmbtu/hr heat input. In the 2018 inventory used to develop the reasonable progress goals, the steam plant had estimated emissions of 6,509 tpy of $SO_2$. The facility received a federally enforceable permit on December 6, 2012, allowing the construction of six natural gas-fired boilers that will be used in place of the seven coal-fired boilers. The retirement of the coal-fired boilers, which operate with minimal pollution control, and their subsequent replacement by natural gas fired-boilers with low $NO_X$ burners, will significantly reduce emissions of $SO_2$ and $NO_X$. Table 27 provides the power house emissions since 2007 from this facility.

The total emissions from the new natural gas boilers are limited to no more than 333 tpy of $NO_X$ and 6 tpy of $SO_2$. Therefore, the steam plant will emit 3,000 tons of $NO_X$ and 6,000 tons of $SO_2$ less than previous years, once these changes are made. The estimated date for these changes to take effect is 2015.

**Table 27: Celco Powerhouse Emissions 2007-2011, $SO_2$ and $NO_X$**

| Year | Tons $NO_X$/Year | Tons $SO_2$/Year |
|---|---|---|
| 2011 | 3,539.9 | 6,540.2 |
| 2010 | 3,438.8 | 6,325.1 |
| 2009 | 3,775.9 | 6,551.1 |
| 2008 | 3,907.1 | 6,631.5 |
| 2007 | 3,609.2 | 6,499.9 |

Data Source: VDEQ-CEDS

The reductions expected to be achieved in 2018 by these four facilities (Bremo Power Station, Potomac River, Invista, and Celco) far exceed the requested 28% reduction from 2002 non-EGU emissions levels (16,181 tpy) of $SO_2$. Table 19 provides information on these units as well as other units that have expected $SO_2$ emissions reductions before 2018. Therefore, Virginia has satisfied the MANEVU "Non-EGU Ask."

### 3.4. Assessment of Visibility Conditions

40 CFR 51.308(g)(3) requires:

> For each class I area in the state, an assessment of the following visibility conditions and changes, with values for most impaired and least impaired days expressed in terms of 5 year averages of these annual values:
>
> (i) Current visibility conditions for the most and least impaired days;

(ii) Difference between current visibility conditions for the most and least impaired days and baseline visibility conditions;
(iii) Change in visibility impairment for the most impaired and least impaired days over the past five years.

40 CFR 51.308(d)(1) requires states to establish RPGs (in dv) for each class I federal area within the state and provide for reasonable progress toward achieving natural visibility. In the Virginia Regional Haze SIP, for 20% worst days, Virginia established a reasonable progress goal for the James River Face Wilderness Area of a 6.7 dv reduction in visibility impairment by 2018, which is significantly greater than the 4.2 dv reduction required to meet the uniform rate of progress necessary to achieve a natural background condition of 11.1 dv by 2064. For Shenandoah National Park, Virginia established a reasonable progress goal for 20% worst days of 7.4 dv reduction in visibility impairment by 2018, which is significantly greater than the 4.2 dv reduction required to meet the uniform rate of progress necessary to achieve a natural background condition of 11.4 dv by 2064. Likewise, Virginia has also adopted a reasonable progress goal for the 20% best days that would result in a 2.2 dv reduction and 1.8 dv reduction in visibility impairment, respectively, for the James River Face Wilderness Area and Shenandoah National Park. These values are provided in Table 11.

An analysis of emission reductions indicates that Virginia is on track to achieve these goals in 2018. Figure 16 and Figure 17 address the three requirements at 40 CFR 51.308 and depict the current visibility conditions at the James River Face Wilderness Area. Figure 18 and Figure 19 provide this information for Shenandoah National Park. These figures also depict the difference between current and baseline visibility and a five-year rolling average for the most impaired (20% worst) and least impaired (20% best) days at both class I areas. As indicated by these figures, visibility at both class I areas has significantly improved since 2000.

Figure 16 and Figure 18 provide recent observations demonstrating that visibility on the 20% worst days is below the glide path for both class I areas. Even when examining the changes in visibility impairment for the most impaired days, taken over a five-year rolling average, both class I areas are meeting their respective RPGs. Moreover, expected future reductions in $SO_2$ emissions based on additional controls and shutdowns will serve to continue this downward trend in the coming years.

In addition to the visibility improvement on the 20% worst days, Figure 17 and Figure 19 demonstrate that visibility on the 20% best days is also improving at both class I areas. Visibility impairment for the least impaired days, taken over a five-year rolling average, is improving more than originally anticipated in the Virginia Regional Haze SIP, and both class I areas are expected to meet or exceed their respective RPG in 2018.

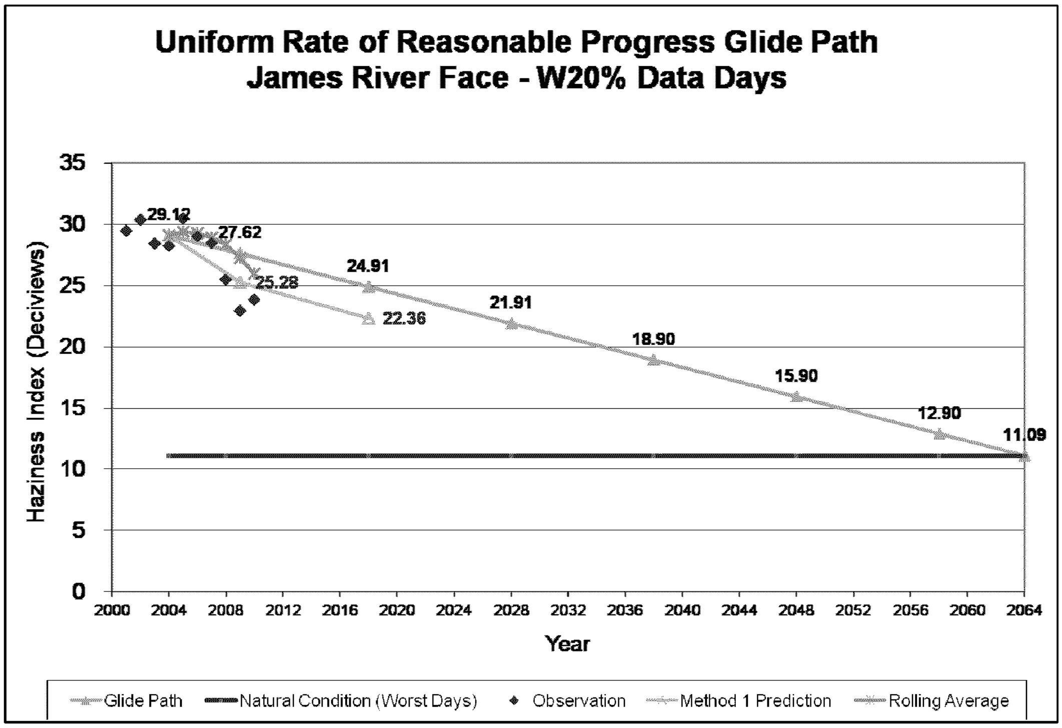


Figure 16: Glide Path for James River Face on 20% Worst Days

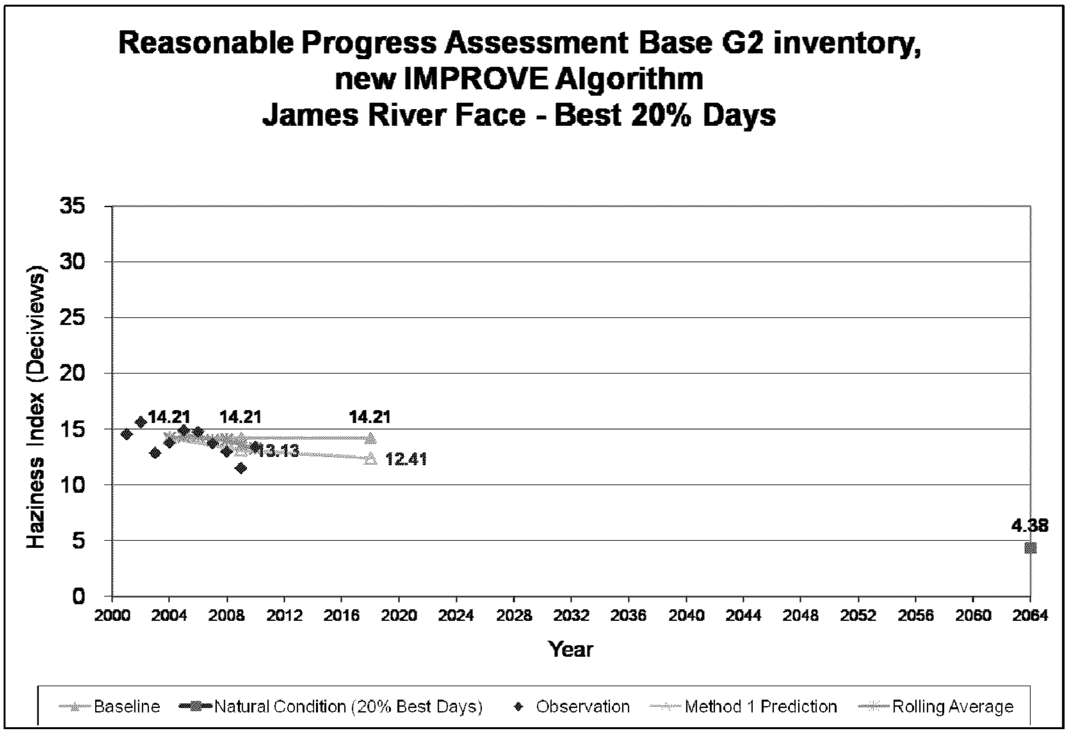


Figure 17: Glide Path for James River Face on 20% Best Days

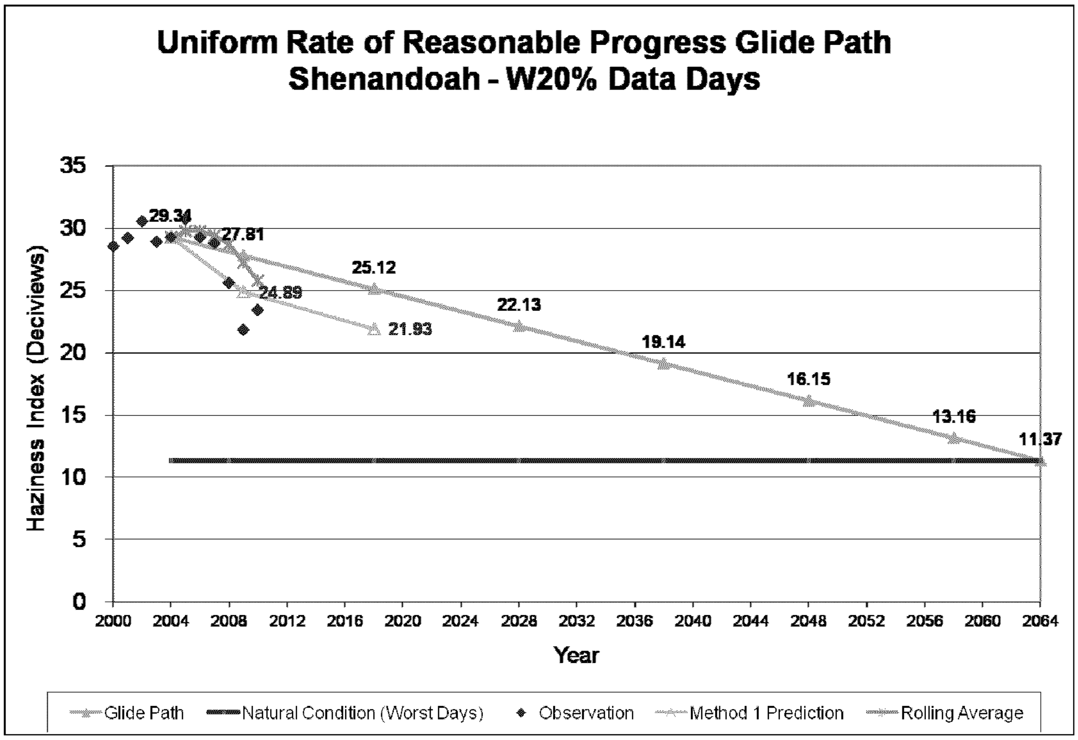


Figure 18: Glide Path for Shenandoah on 20% Worst Days

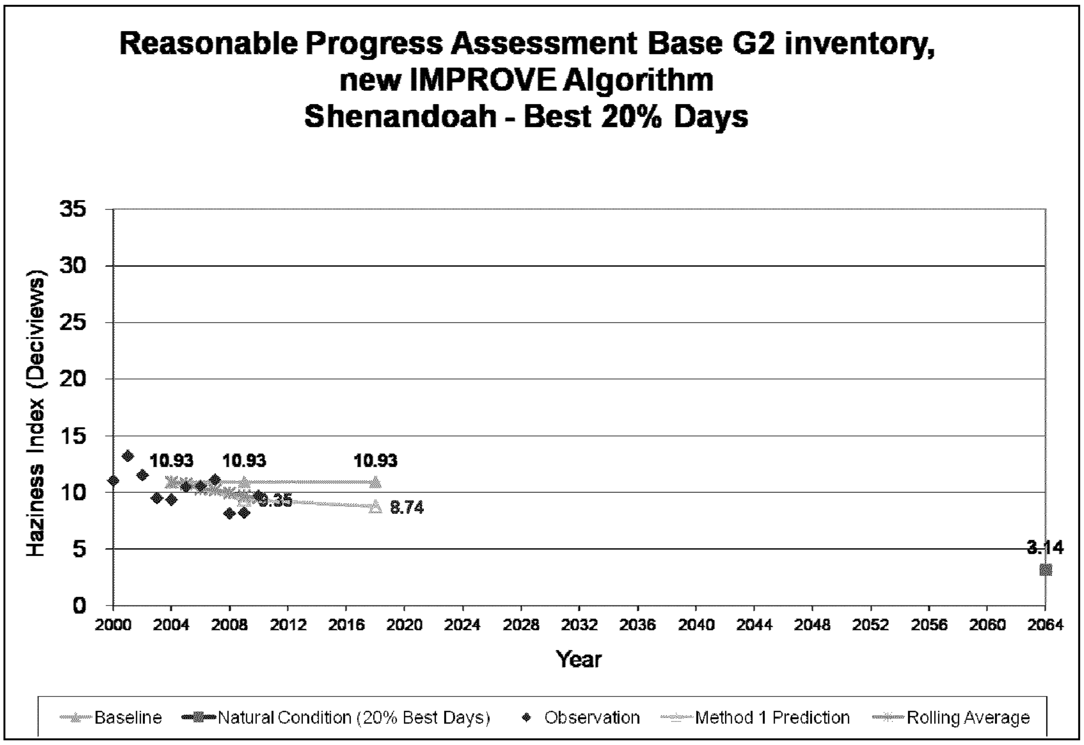


Figure 19: Glide Path for Shenandoah on 20% Best Days

Visibility data depicted in Figure 16, Figure 17, Figure 18, and Figure 19 are provided in Table 28. Data for 2011 are also included in Table 28 since this data has recently become available. The data for 2011 continues to show improvement in the five-year average values for the James River Face Wilderness Area and the Shenandoah National Park. Annual values for the 20% best days in 2011 were as low as had been recorded in the last decade.

**Table 28: Visiblity Data**

| Year | James River Face Wilderness Area | | | | Shenandoah National Park | | | |
|---|---|---|---|---|---|---|---|---|
| | 20% Worst Days | | 20% Best Days | | 20% Worst Days | | 20% Best Days | |
| | Annual | 5 Year Ave | Annual | 5 Year Ave | Annual | 5 Year Ave | Annual | 5 Year Ave |
| 2001 | 29.5 | --- | 14.5 | --- | 29.2 | --- | 13.2 | --- |
| 2002 | 30.4 | --- | 15.7 | --- | 30.5 | --- | 11.5 | --- |
| 2003 | 28.4 | --- | 12.9 | --- | 28.9 | --- | 9.5 | --- |
| 2004 | 28.2 | --- | 13.8 | --- | 29.3 | --- | 9.4 | --- |
| 2005 | 30.5 | 29.4 | 14.9 | 14.4 | 30.8 | 29.8 | 10.5 | 10.8 |
| 2006 | 29.0 | 29.3 | 14.8 | 14.4 | 29.3 | 29.8 | 10.6 | 10.3 |
| 2007 | 28.5 | 28.9 | 13.8 | 14.0 | 28.8 | 29.4 | 11.1 | 10.2 |
| 2008 | 25.5 | 28.4 | 13.0 | 14.1 | 25.7 | 28.8 | 8.2 | 10.0 |
| 2009 | 22.9 | 27.3 | 11.6 | 13.6 | 21.8 | 27.3 | 8.2 | 9.7 |
| 2010 | 23.9 | 26.0 | 13.4 | 13.3 | 23.4 | 25.8 | 9.7 | 9.6 |
| 2011 | 24.3 | 24.4 | 11.5 | 12.7 | 23.4 | 24.6 | 7.8 | 9.0 |

As discussed in the Virginia Regional Haze SIP, the greatest benefits on the 20% worst visibility days for the James River Face Wilderness Area and Shenandoah National Park were projected to result from reducing $SO_2$ from EGUs. As outlined in sections 3.1, 3.2, and 3.3, the reductions in $SO_2$ emissions from EGUs in Virginia have been significant and are expected to continue over the next five years.

Virginia committed in the Regional Haze SIP to re-examine the need for additional non-EGU controls during this, the state's five-year progress report. As evidenced by the current and future $SO_2$ emission reductions from EGUs, facilitating further reductions from non-utility, industrial point sources is unnecessary at this time.

## 3.5. Analysis of Emissions Changes by Source Category

40 CFR 51.308(g)(4) requires:

> An analysis tracking the change over the past 5 years in emissions of pollutants contributing to visibility impairment from all sources and activities within the State. Emissions changes should be identified by type of source or activity. The analysis must be based on the most recent updated emissions inventory, with estimates projected forward as necessary and appropriate, to account for emissions changes during the past 5-year period."

Moreover, the RHR goes on to require that, "Each 5 year progress report must contain . . . An emissions tracking report that analyzes the changes over the past 5 years in emissions of pollutants contributing to visibility impairment, disaggregated by source category and emissions activity, for significant categories of sources or activities."

40 CFR 51.308(d)(4)(v) requires a statewide inventory of pollutants that are reasonably anticipated to cause or contribute to visibility impairment. As such, the VISTAS states developed an inventory for the base year of 2002, along with estimated inventories for future years of 2009 and 2018. The pollutants inventoried include VOC, $NO_X$, $PM_{2.5}$, fine particulate matter 10 angstroms in diameter or less ($PM_{10}$), $NH_3$, and $SO_2$. Five emission inventory source classifications were developed: stationary point and area sources, off-road and on-road mobile sources, and biogenic sources. Throughout the course of work to develop the Regional Haze SIPS, VISTAS made several improvements to the emissions inventory to improve model performance. Appendix D of the Virginia Regional Haze SIP describes in depth the state's efforts with regard to the initial emission inventory development and subsequent emission tracking.

The Virginia Regional Haze SIP was developed using the Base G2 Emission Inventory. A final iteration of the emissions inventory known as Base G4 (Best and Final) was made available in 2008. The Southeastern Modeling, Analysis, and Planning (SEMAP) project is funded by EPA and the same ten states originally involved in the VISTAS project. The organizational change was primarily an administrative convenience (e.g., to address grant funding constraints). The SEMAP project addresses the next phase of ozone, $PM_{2.5}$, and regional haze assessment obligations of the member states. The SEMAP project was designed to produce technical analyses to aid the participating agencies in developing SIPs required by the CAA, including the development of a 2007 inventory for the Southeastern states. The 2007 SEMAP inventory is the most recent historical inventory that has been fully quality-assured. In October of 2013, EPA released version 1 of the National Emissions Inventory (NEI) for 2011. This 2011 data, when combined with available state-level information, provides the basis for a 2011 base year inventory. Table 29 summarizes for Virginia the 2002 and 2007 base year inventories, the 2011 NEI inventory supplemented with state information, and the Base G4 2009 and Base G4 2018 projection inventories.

**Table 29: Virginia Inventories Summary**

| VISTAS 2002 Actual Base Year Inventory for Virginia | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **CO** | **$NH_3$** | **$NO_X$** | **$PM_{10}$** | **$PM_{2.5}$** | **$SO_2$** | **VOC** |
| Point | 70,688 | 3,230 | 147,300 | 17,211 | 12,771 | 305,106 | 43,906 |
| Area | 155,873 | 43,905 | 51,418 | 237,577 | 43,989 | 105,890 | 172,989 |
| Onroad | 2,163,259 | 7,852 | 222,374 | 4,549 | 3,102 | 8,294 | 159,790 |
| Nonroad | 660,105 | 48 | 63,219 | 8,728 | 8,288 | 8,663 | 75,993 |
| Fires | 22,172 | 173 | 1,043 | 18,453 | 17,612 | 117 | 1,054 |
| **Total** | **3,072,097** | **55,208** | **485,354** | **286,518** | **85,762** | **428,070** | **453,732** |
| **VISTAS 2002 Typical Base Year Inventory for Virginia** | | | | | | | |
| | **CO** | **$NH_3$** | **$NO_X$** | **$PM_{10}$** | **$PM_{2.5}$** | **$SO_2$** | **VOC** |
| Point | 70,581 | 3,234 | 145,471 | 17,144 | 12,815 | 297,591 | 43,899 |
| Area | 155,873 | 43,905 | 51,418 | 237,577 | 43,989 | 105,890 | 172,989 |
| Onroad | 2,163,259 | 7,852 | 222,374 | 4,549 | 3,102 | 8,294 | 159,790 |
| Nonroad | 660,105 | 48 | 63,219 | 8,728 | 8,288 | 8,663 | 75,993 |
| Fires | 19,159 | 159 | 978 | 18,160 | 17,361 | 99 | 912 |
| **Total** | **3,068,977** | **55,198** | **483,460** | **286,158** | **85,555** | **420,537** | **453,583** |

| SEMAP 2007 Base Year Inventory for Virginia | | | | | | | |
|---|---|---|---|---|---|---|---|
| | CO | $NH_3$ | $NO_X$ | $PM_{10}$ | $PM_{2.5}$ | $SO_2$ | VOC |
| Point | 72,029 | 1,830 | 112,938 | 19,203 | 14,876 | 243,048 | 35,618 |
| Area | 63,838 | 43,038 | 17,740 | 176,265 | 39,034 | 17,022 | 133,935 |
| Onroad | 1,188,911 | 4,041 | 196,744 | 8,051 | 6,512 | 1,429 | 96,297 |
| Nonroad | 446,156 | 64 | 90,600 | 6,670 | 6,131 | 7,277 | 59,710 |
| Fires | 54,529 | 77 | 1,669 | 5,921 | 5,727 | 101 | 3,759 |
| **Total** | **1,825,463** | **49,050** | **419,690** | **216,110** | **72,279** | **268,877** | **329,320** |
| **VISTAS 2009 Base G4 Projection Inventory for Virginia** | | | | | | | |
| | CO | $NH_3$ | $NO_X$ | $PM_{10}$ | $PM_{2.5}$ | $SO_2$ | VOC |
| Point | 80,861 | 3,739 | 115,358 | 18,652 | 14,153 | 232,816 | 44,514 |
| Area | 128,132 | 46,639 | 52,618 | 252,488 | 44,514 | 105,984 | 145,675 |
| Onroad | 1,453,946 | 9,086 | 134,232 | 3,747 | 2,241 | 1,079 | 96,770 |
| Nonroad | 726,815 | 53 | 54,993 | 7,510 | 7,136 | 1,707 | 58,368 |
| Fires | 19,159 | 159 | 978 | 18,160 | 17,361 | 99 | 912 |
| **Total** | **2,408,913** | **59,676** | **358,179** | **300,557** | **85,405** | **341,685** | **346,239** |
| **2011 NEI Version 1 Inventory for Virginia with Supplemental Data** | | | | | | | |
| | CO | $NH_3$ | $NO_X$ | $PM_{10}$ | $PM_{2.5}$ | $SO_2$ | VOC |
| Point | 28,689 | 1,616 | 78,668 | 14,956 | 6,167 | 104,643 | 23,241 |
| Area | 131,999 | 44,683 | 25,763 | 155,785 | 41,741 | 6,537 | 131,598 |
| Onroad | 717,574 | 3,422 | 148,847 | 6,197 | 4,844 | 797 | 66,732 |
| Nonroad | 385,540 | 63 | 71,328 | 4,971 | 4,699 | 1,976 | 49,123 |
| Fires | 167,725 | 2,718 | 3,003 | 17,828 | 14,990 | 1,483 | 39,279 |
| **Total** | **1,431,527** | **52,502** | **327,609** | **199,737** | **72,441** | **115,436** | **309,973** |
| **VISTAS 2018 Base G4 Projection Inventory for Virginia** | | | | | | | |
| | CO | $NH_3$ | $NO_X$ | $PM_{10}$ | $PM_{2.5}$ | $SO_2$ | VOC |
| Point | 95,696 | 4,210 | 120,078 | 27,662 | 22,378 | 156,778 | 54,166 |
| Area | 121,690 | 50,175 | 56,158 | 275,351 | 46,697 | 109,380 | 149,262 |
| Onroad | 1,092,980 | 10,759 | 64,785 | 3,261 | 1,568 | 1,058 | 63,046 |
| Nonroad | 797,683 | 61 | 40,393 | 6,208 | 5,891 | 507 | 50,708 |
| Fires | 19,159 | 159 | 978 | 18,160 | 17,361 | 99 | 912 |
| **Total** | **2,127,208** | **65,364** | **282,392** | **330,642** | **93,895** | **267,822** | **318,094** |

Although emissions inventories for 2002, 2007, 2009, 2011, and 2018 are presented, comparisons between the inventories are difficult. The 2002 inventories represent actual and typical historical emissions, while the 2009 and 2018 inventories are projection inventories, based on predictions of future events. All inventories are estimates of emissions based on the best assumptions available at the time of development. Development of estimates for the 2002, 2009, and 2018 inventories began in 2004 and finished in 2007. The projections for 2009 and 2018 reflected a scenario accounting for all in-place controls that were fully adopted into federal or individual state regulations or SIPs. Controls to comply with the CAIR were included in what was referred to as the "On the Books/On the Way" scenario. Several versions of the inventories were developed, with improvements made in each subsequent version. The final VISTAS inventory was Base G4. The 2007 inventory was prepared by SEMAP and finalized in 2012. The 2011 NEI inventory uses state-supplied data or model inputs for area and nonroad estimates. The 2011 onroad estimates in Table 29 are based on VDEQ's MOVES2010 modeling runs that use county-specific inputs for all 134 Virginia jurisdictions and that use the model's inventory mode. The 2011 point information in Table 29 is based on 2011 CAMD data for those point source units reporting to CAMD or on data from Virginia's Comprehensive Environmental Data System (CEDS). Data supplied to CEDS must be certified by facility officials as being true and complete according to the best available knowledge and is quality-assured by VDEQ staff. Virginia point source information originating from CEDS is a larger universe of units and facilities than those in the NEI.

The estimates for 2002, 2009, and 2018 used different assumptions than those used to develop the SEMAP 2007 estimates and the 2011 estimates. Inventories of current emissions require the use of emission factors based on surrogate data, since direct measurements are not often available. Projections of future emissions also involve assumptions concerning economic growth, population growth, growth in fuel consumption, as well as the balance among different fuels used, such as coal, oil, and natural gas. There have been significant changes during this time period in many of these assumptions that were not foreseen when the 2009 and 2018 projections were made. Examples of these unforeseen circumstances include the decline in natural gas prices, the rise in coal prices, and the retirement of many coal-fired power plants. EPA has also updated emission factors. Further adding to the confusion are changes in proscribed emissions models; for example, Mobile 6.2 and MOVES, while both used to estimate onroad mobile source emissions, give significantly different results for similar inputs.

Documentation for the 2002, 2009, and 2018 VISTAS inventories is contained in Appendix D of the Virginia Regional Haze SIP. Documentation for the 2007 SEMAP inventory and the 2011 inventory is contained in Appendix A to this Progress Report.

VISTAS identified sulfate as the major contributor to regional haze, and focused efforts on the control of $SO_2$ from point sources, primarily EGUs and industrial boilers. As can be seen in Figure 20, $SO_2$ emissions in 2007 and 2011 were beneath the projected estimates. Further, as shown earlier in Table 20 and Figure 12, EGU emissions of $SO_2$ have decreased significantly.

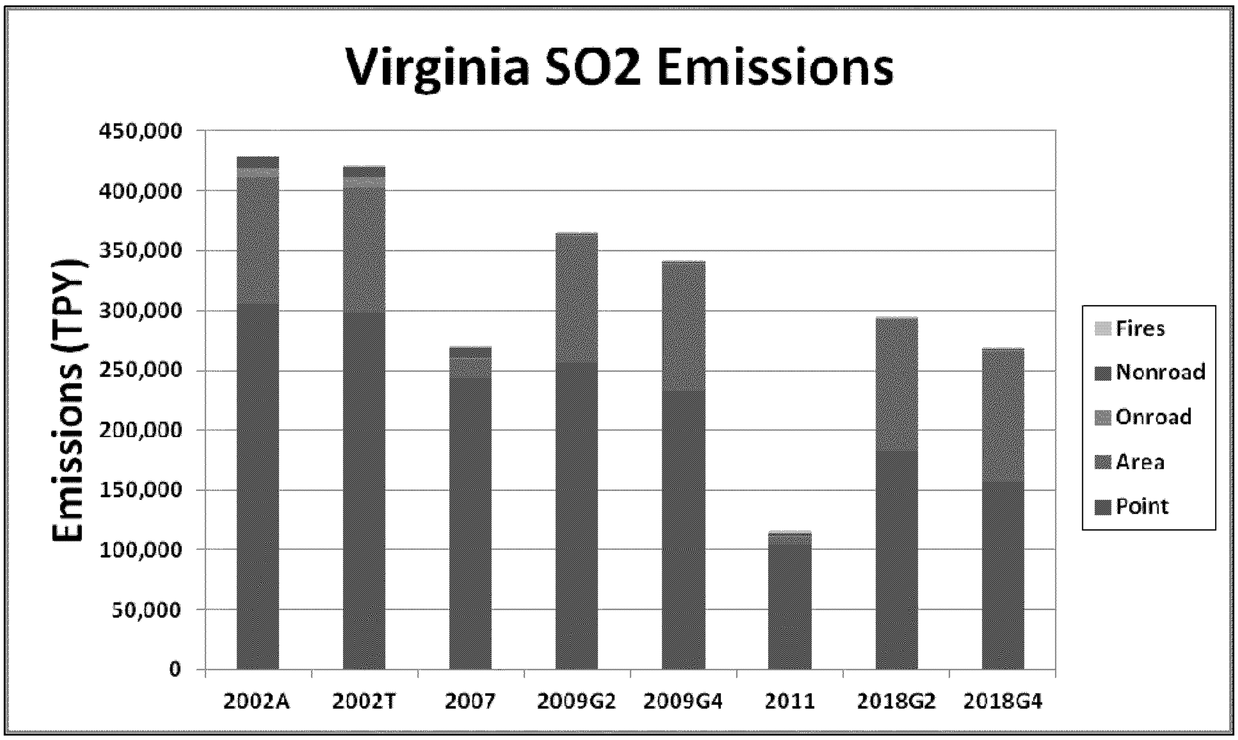


**Figure 20: Virginia Inventories: $SO_2$ Emissions Summary**

### 3.6. Assessment of Significant Changes in Anthropogenic Emissions

40 CFR 51.308(g)(5) requires:

> An assessment of any significant changes in anthropogenic emissions within or outside the state that have occurred over the past 5 years that have limited or impeded progress in reducing pollutant emissions and improving visibility.

Figure 21 and Figure 22 indicate that sulfates continue to be the largest single contributor to regional haze at both James River Face Wilderness Area and Shenandoah National Park. As explained elsewhere, Virginia focused the analysis for its Regional Haze SIP on addressing large $SO_2$ emissions from point sources.

After ammonium sulfate, the next largest fraction of regional haze at both class I areas is primary organic matter (POM). While sulfates continue to be the largest contributor to visibility impairment, the contributions of POM, ammonium nitrate (Amm $NO_3$) and elemental carbon (EC) are also of concern. This information is shown as daily averages in Figure 23, Figure 24, Figure 25, and Figure 26 for both 20% best days and 20% worst days at James River Face Wilderness Area and Shenandoah National Park.

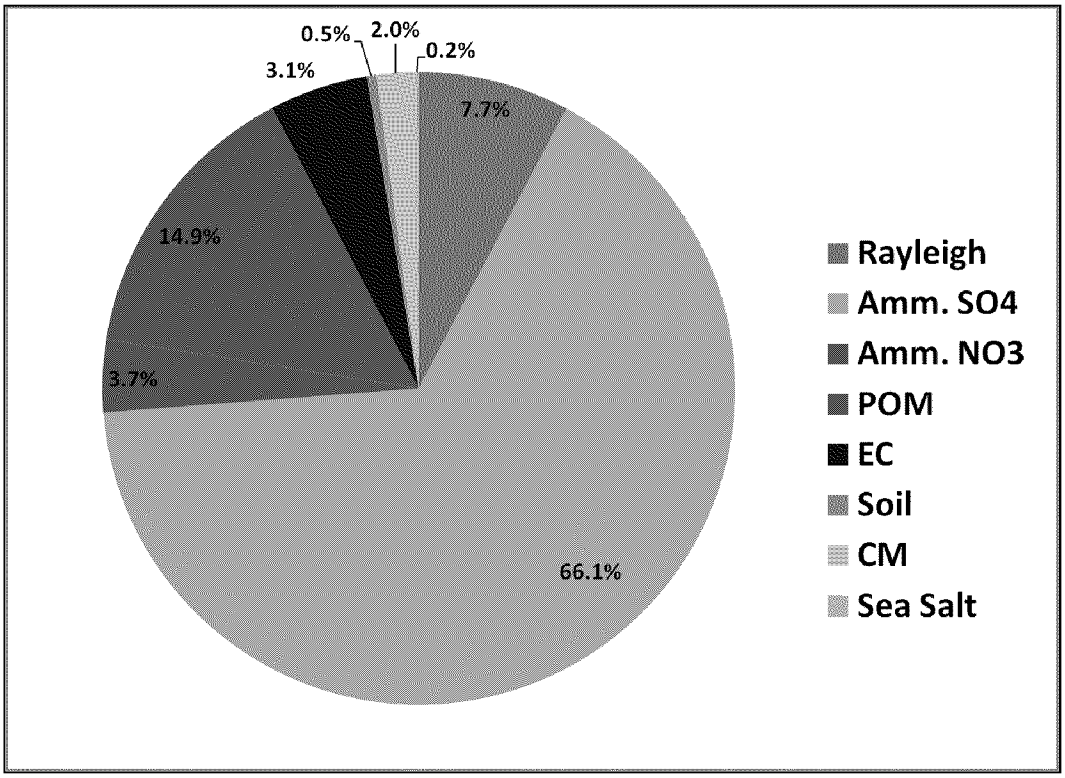


**Figure 21: 5-Year Average Light Extinction Values for Major Haze Components at James River Face, 20% Worst Days (2006-2010)**

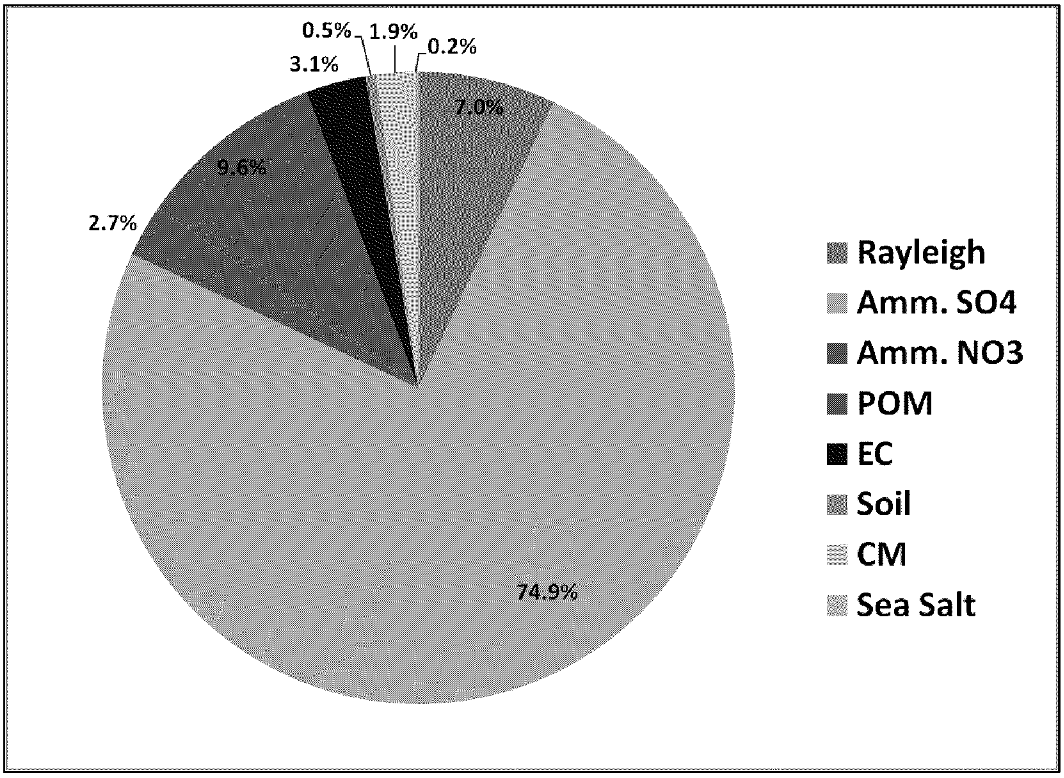


**Figure 22: 5-Year Average Light Extinction Values for Major Haze Components at Shenandoah, 20% Worst Days (2006-2010)**

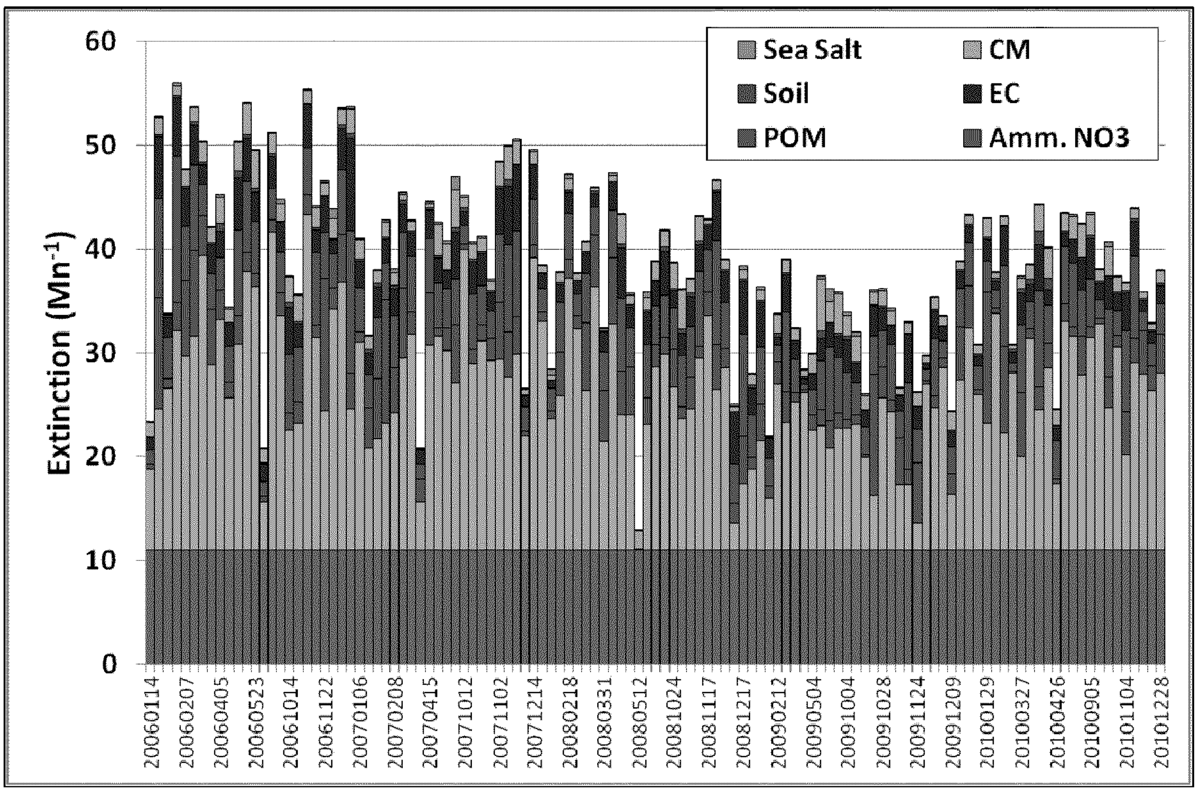


**Figure 23: Major Component Contribution on 20% Best Days, James River Face (2006-2010)**

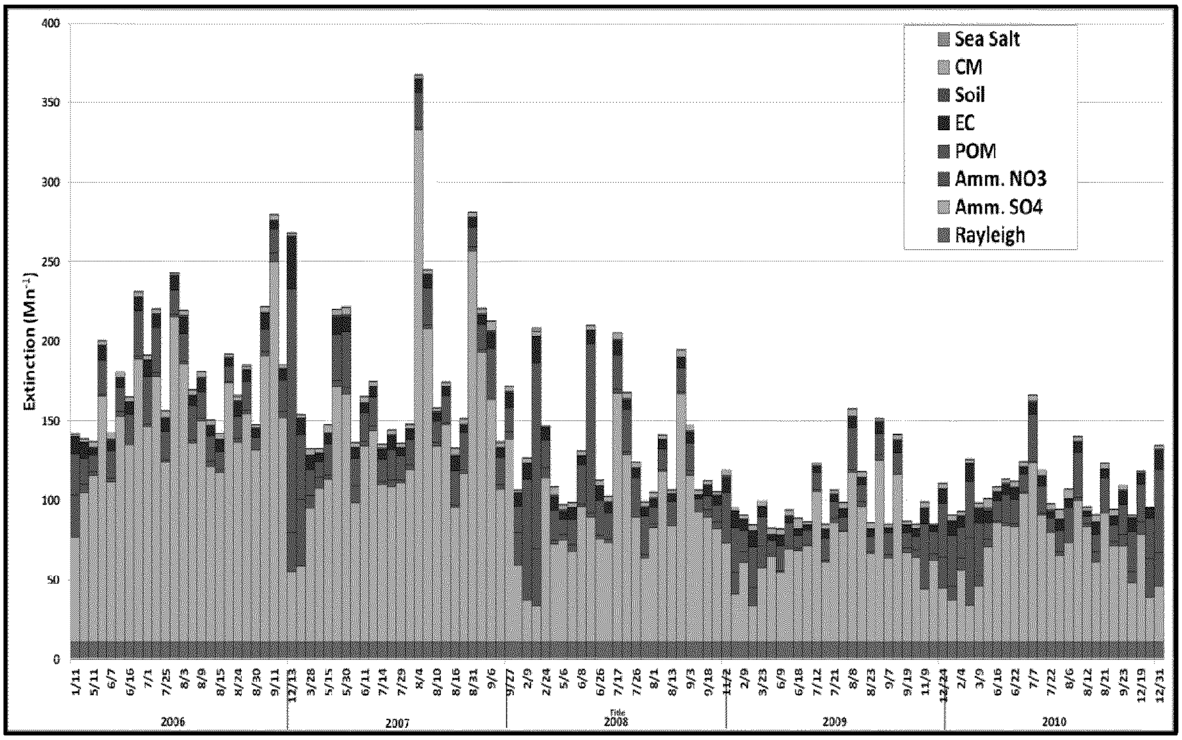


**Figure 24: Major Component Contribution on 20% Worst Days, James River Face (2006-2010)**

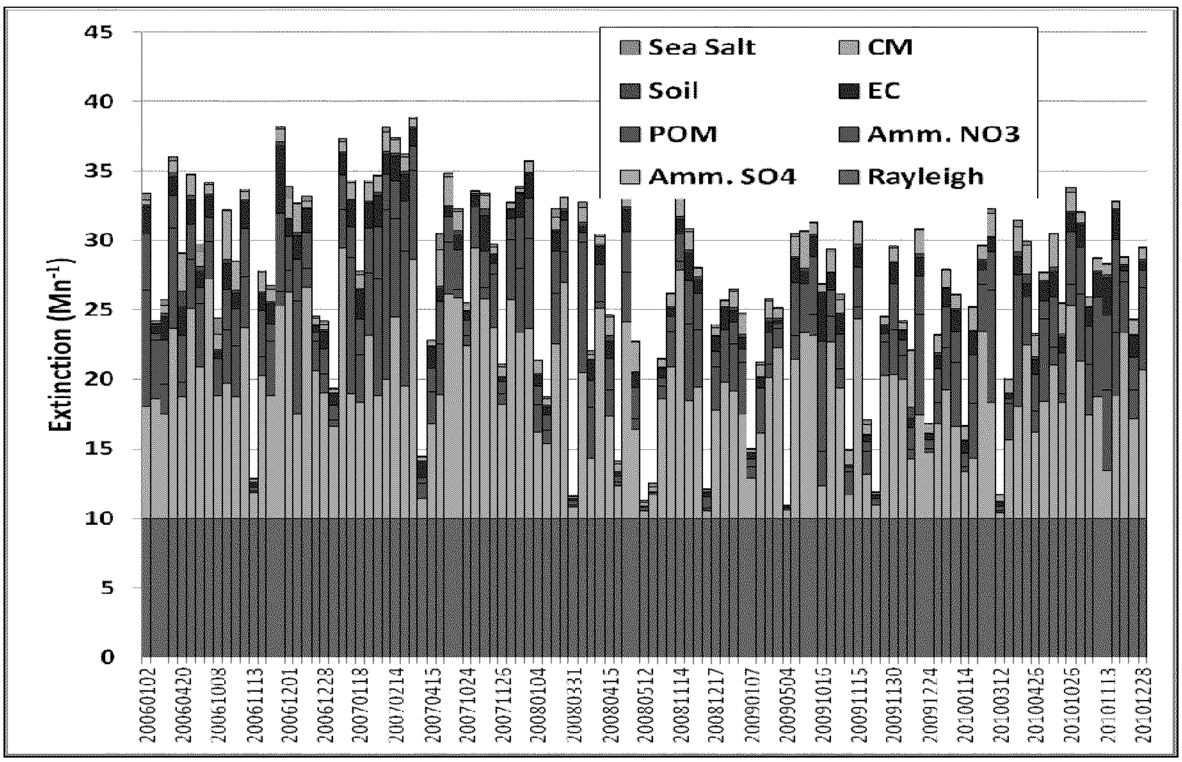


**Figure 25: Major Component Contribution on 20% Best Days, Shenandoah (2006-2010)**

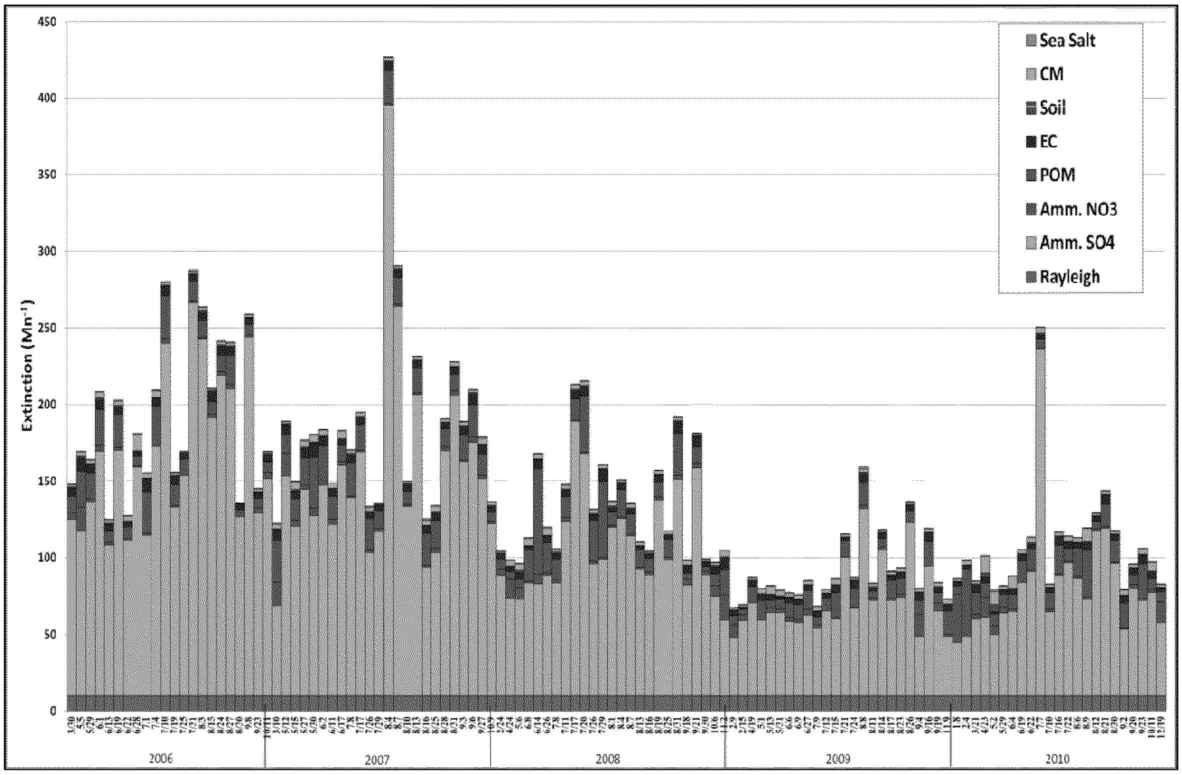


**Figure 26: Major Component Contribution on 20% Worst Days, Shenandoah (2006-2010)**

Analyses of the annual averages by species on the 20% worst days for 2001 through 2010 at James River Face Wilderness Area and for 2000 through 2010 at Shenandoah National Park show a significant improvement in visibility and a significant decrease in the sulfate contribution to visibility impairment. This data is provided in Figure 27 and Figure 28.

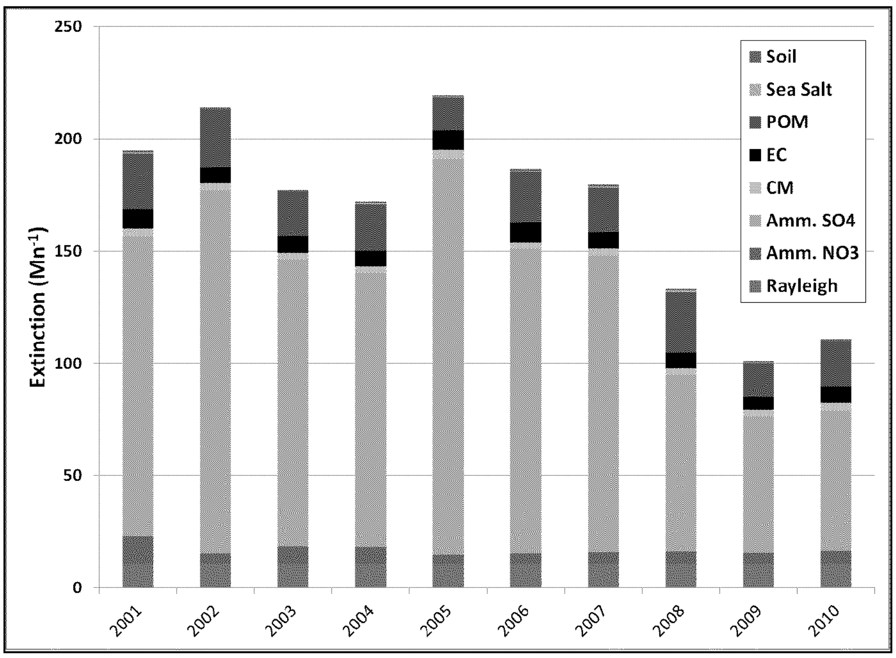


**Figure 27: James River Face Annual Average Species Contribution, 20% Worst Days**

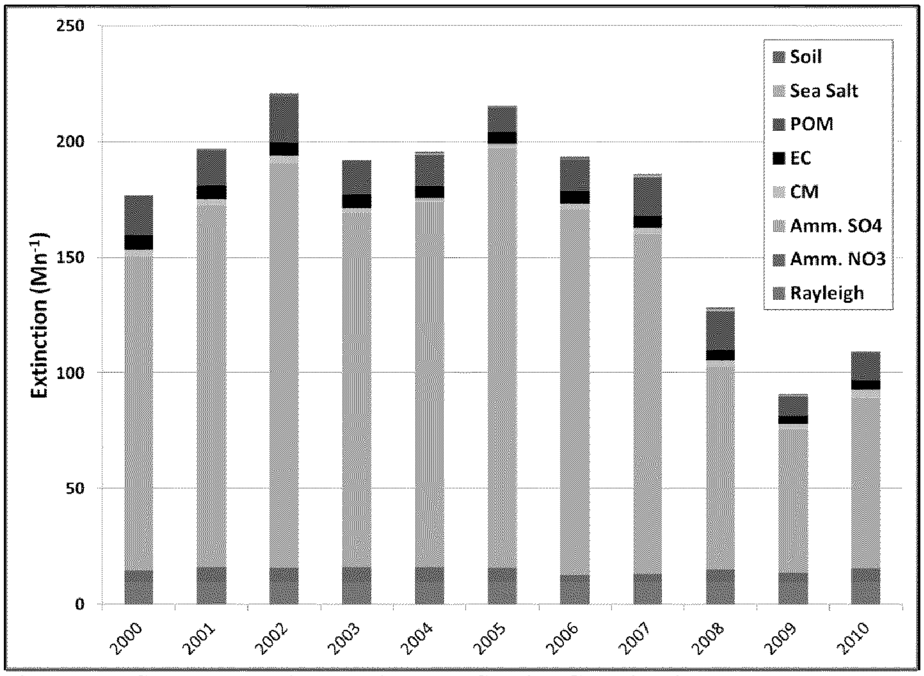


**Figure 28: Shenandoah Annual Average Species Contribution, 20% Worst Days**

Analyses of these same metrics for James River Face Wilderness Area and Shenandoah National Park show that visibility impairment is also improving on 20% best visibility days. Contributions from sulfate are decreasing on these days, as seen in Figure 29 and Figure 30, although the decreases are much less significant than those seen on 20% worst visibility days.

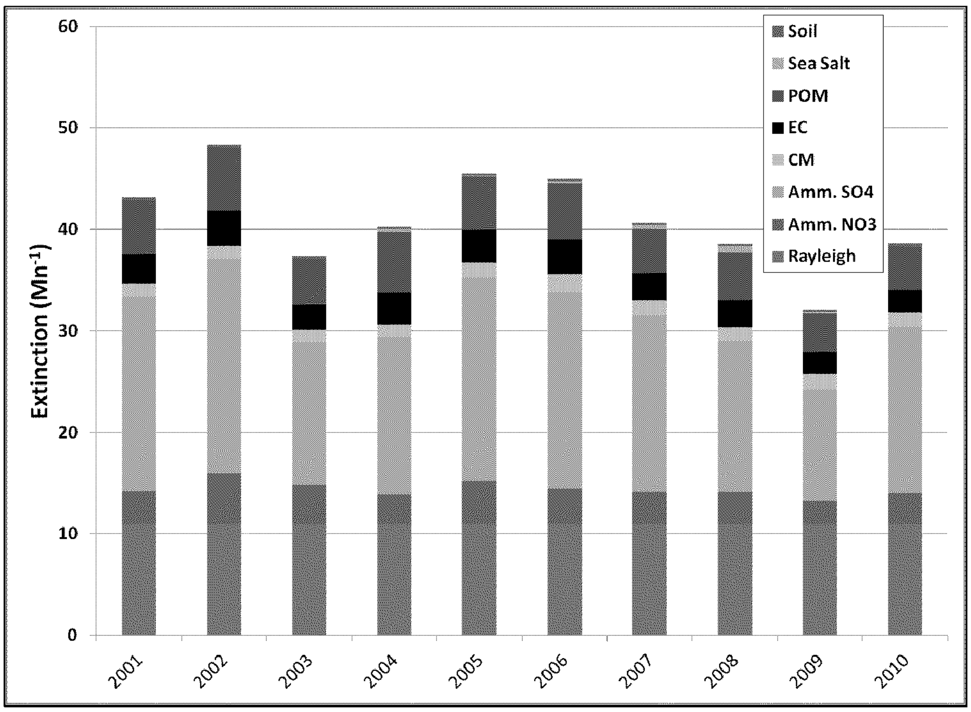


**Figure 29: James River Face Annual Average Species Contribution, 20% Best Days**

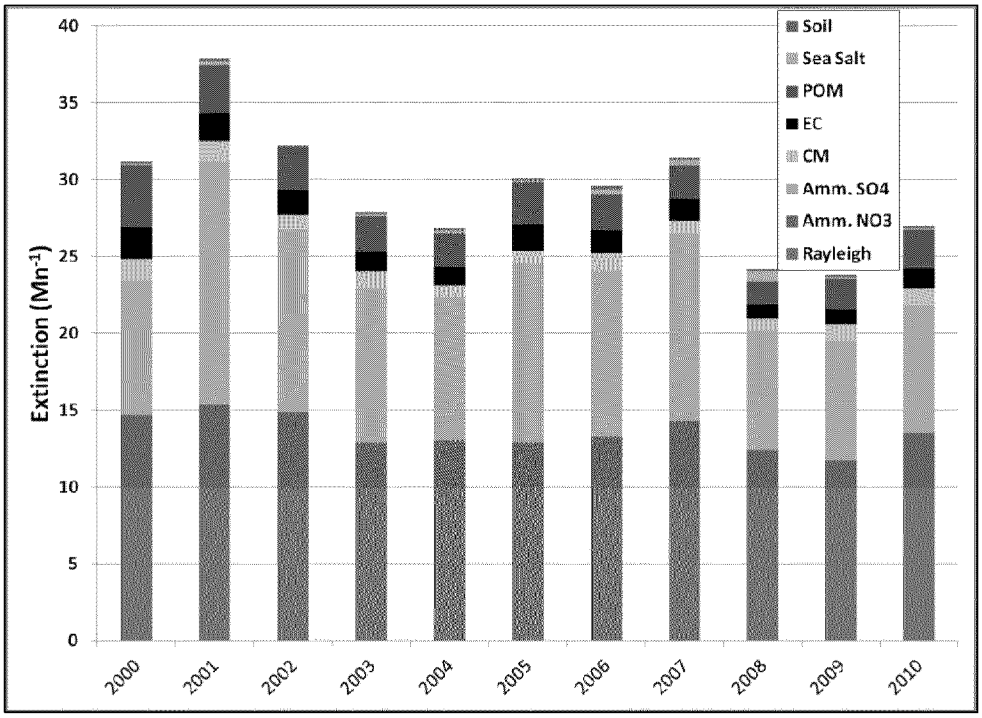


**Figure 30: Shenandoah Annual Average Species Contribution, 20% Best Days**

As the emissions inventory data in Table 29 demonstrates, $SO_2$ emissions from point sources dominate the inventory for this pollutant. Table 30 provides estimated point source emissions from 2005 to 2011 for Virginia facilities. These data, derived from CEDS, show that $SO_2$ emissions from point sources, as well as other criteria pollutants, have been decreasing. These data demonstrate that changes in anthropogenic emissions should not be negatively affecting visibility at Virginia class I areas. Rather, the emission reductions from 2005 through 2011 should be improving visibility at Virginia class I areas, as predicted in the Virginia Regional Haze SIP.

**Table 30: Virginia Point Source Emissions, 2005-2011**

| Year | $NO_X$, tpy | $PM_{10}$, tpy | $SO_2$, tpy | VOC, tpy |
|---|---|---|---|---|
| 2005 | 125,189 | 19,592 | 291,635 | 43,180 |
| 2006 | 108,729 | 15,706 | 249,979 | 41,039 |
| 2007 | 114,471 | 15,437 | 243,744 | 31,807 |
| 2008 | 59,215 | 10,501 | 128,430 | 19,288 |
| 2009 | 78,703 | 19,107 | 137,034 | 27,241 |
| 2010 | 84,772 | 17,056 | 131,049 | 25,108 |
| 2011 | 78,668 | 14,956 | 104,643 | 23,241 |

## 3.7. Assessment of Elements and Strategies for Meeting RPGs

40 CFR 51.308(g)(6) requires:

> An assessment of whether the current implementation plan elements and strategies are sufficient to enable the state, or other states with class I area affected by emissions from the State, to meet all established reasonable progress goals.

Based upon the relevant data, projected emissions, and modeling results, the current implementation plan elements and strategies outlined in the original Virginia Regional Haze SIP are sufficient to enable the state and other neighboring states to meet all established RPGs.

The following sections provide information on any class I area where any Virginia point source was found to have contributed to the calculated sulfate visibility impairment in 2018. The sections include a short description of the class I area and information on each area's visibility and impact assessments. This data demonstrates the progress each class I area has made toward improving visibility. The same information is provided for Brigantine, New Jersey since this class I area was the subject of a consultation request by MANE-VU in the Virginia Regional Haze SIP.

### *3.7.1. James River Face Wilderness Area, Virginia*

#### 3.7.1.1 Description

James River Face Wilderness Area is located in Bedford and Rockbridge Counties in west central Virginia. The first designated wilderness in Virginia (1975), James River Face Wilderness Area is bounded on the northeast by the James River and on the south by Petites Gap Road. The land reaches a high point of 3,073 feet on Highcock Knob, near the southern boundary, and a low point of about 650 feet near the river.

#### 3.7.1.2 Assessment

As discussed in section 3.4, an analysis of emissions reductions and visibility data indicates that Virginia is on track to achieve the RPGs for James River Face Wilderness Area in 2018. Figure 16 and Figure 17 provide visibility data for the 20% worst days and 20% best days, respectively, for this class I area. These data address the three requirements of 40 CFR 51.308 and depict the current visibility conditions, the difference between the current and baseline visibility, and a five-year rolling average for the most (20% worst) and least (20% best) impaired days at James River Face Wilderness Area. Visibility has significantly improved since 2000, and visibility on the 20% worst days is below the glide path that targets the achievement of natural visibility conditions by 2064. The more recent data indicates that James River Face Wilderness Area is also meeting its RPG, and expected future reductions in $SO_2$ emissions as discussed in sections 3.2 and 3.3 will serve to continue this downward trend in the coming years.

### *3.7.2. Shenandoah National Park, Virginia*

#### 3.7.2.1 Description

The 197,000 acres of Shenandoah National Park stretch for 80 miles along the Blue Ridge Mountains, which form the eastern boundary of the Appalachian Range. The Park was established in 1936, and the natural regeneration to the "wilderness" conditions that followed encouraged National Park Service officials to recommend and eventually designate 42% of the Park as wilderness.

3.7.2.2 Assessment

As discussed in section 3.4, an analysis of emissions reductions and visibility data indicates that Virginia is on track to achieve the RPGs for Shenandoah National Park in 2018. Figure 18 and Figure 19 provide visibility data for the 20% worst days and 20% best days, respectively, for this class I area. These data address the three requirements of 40 CFR 51.308 and depict the current visibility conditions, the difference between the current and baseline visibility, and a five-year rolling average for the most (20% worst) and least (20% best) impaired days at Shenandoah National Park. Visibility has significantly improved since 2000, and visibility on the 20% worst days is below the glide path that targets the achievement of natural visibility conditions by 2064. The more recent data indicates that Shenandoah National Park is also meeting its RPG, and expected future reductions in $SO_2$ emissions as discussed in sections 3.2 and 3.3 will serve to continue this downward trend in the coming years.

*3.7.3. Dolly Sods Wilderness Area and Otter Creek Wilderness Area, West Virginia*

3.7.3.1 Description

The Dolly Sods Wilderness, located on the Allegheny Plateau, is known for its extensive rocky plains, upland bogs, and forest. Otter Creek Wilderness Area lies in a natural bowl between Shavers Mountain and McGowan Mountain. Most of the numerous streams in the area flow into Otter Creek, which runs north across the Wilderness into the Dry Fork River. From the mouth of Otter Creek, the terrain rises to about 3,900 feet on McGowan Mountain. The area contains a second-growth forest.

3.7.3.2 Assessment

During the Virginia Regional Haze SIP development, as explained in section 2, VISTAS identified the $SO_2$ AoI for class I areas in the VISTAS region and neighboring regions, including Dolly Sods Wilderness Area. The AoI for Dolly Sods Wilderness Area is shown in Figure 31. Otter Creek Wilderness Area does not contain a visibility monitor, and Dolly Sods Wilderness Area information serves as the analysis for the Otter Creak Wilderness Area.

There were 322 units identified within the AoI that were projected to contribute to the sulfate at Dolly Sods Wilderness Area, including 10 units in Virginia. Table 31 provides the calculated $SO_2$ point source contributions by state to the area.

Twenty-nine units were projected to have a relative contribution greater than 0.5% and contribute 71.65% to sulfate, one of which is located in Virginia. Stack 25 at MeadWestvaco Covington was the subject of both a BART analysis, as described in Table 16, and a Reasonable Progress analysis, as described in Table 17. Fifteen units were projected to have a relative contribution greater than 1.0% and contribute 62.43% to sulfate. As shown in Figure 32 and Figure 33, which provide the glide path information as well as measured data for the 20% worst visibility days and the 20% best visibility days at Dolly Sods Wilderness Area, this class I area is on track to achieve its RPG in 2018.

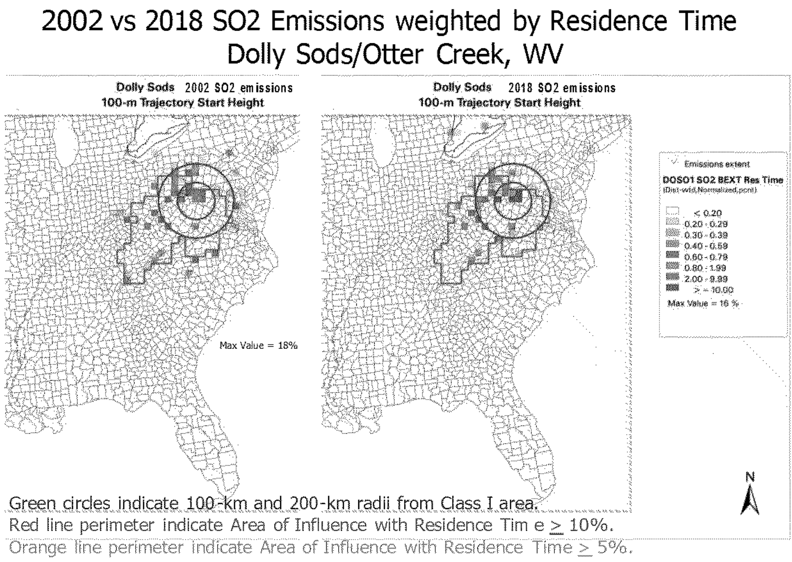


**Figure 31: Dolly Sods 2002 and 2018 AOI Plots**

**Table 31: 2018 Calculated $SO_2$ Point Source Contributions to Dolly Sods by State**

| State | Relative Contribution | State | Relative Contribution |
|---|---|---|---|
| Kentucky | 1.34% | South Carolina | 0.09% |
| Maryland | 11.81% | Tennessee | 1.25% |
| North Carolina | 0.80% | Virginia | 5.73% |
| Ohio | 7.37% | West Virginia | 66.35% |
| Pennsylvania | 5.26% | | |

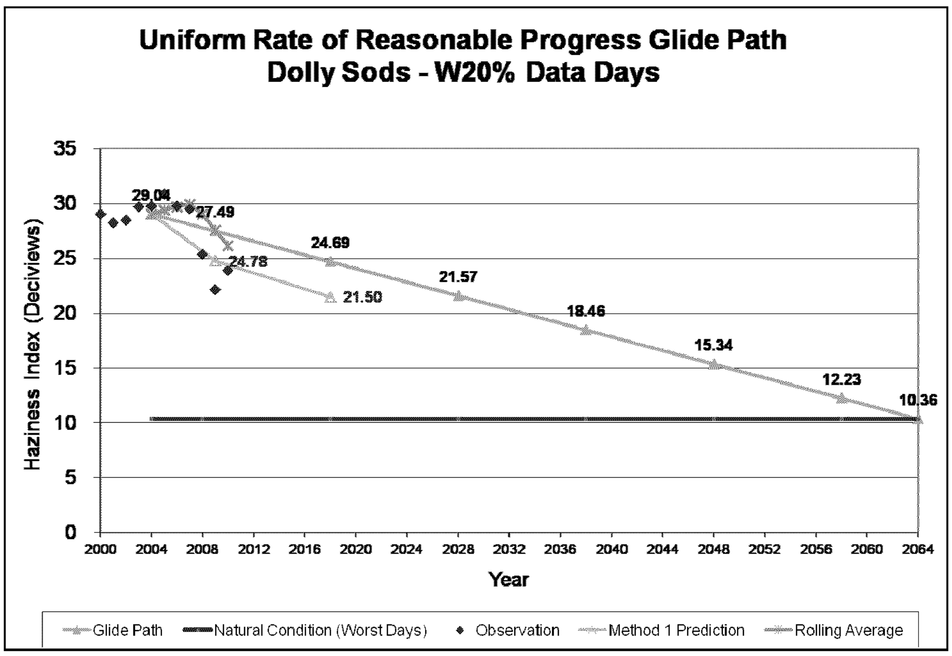


**Figure 32: Glide Path for Dolly Sods on 20% Worst Days**

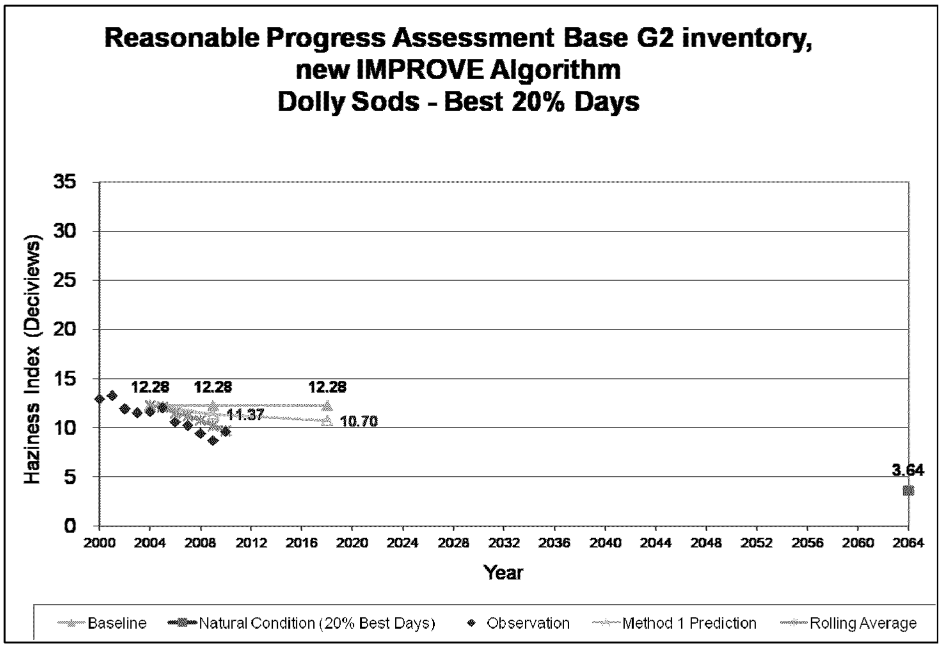


**Figure 33: Glide Path for Dolly Sods on 20% Best Days**

### *3.7.4. Great Smoky Mountains National Park, North Carolina and Tennessee*

#### 3.7.4.1 Description

Established in 1934, Great Smoky Mountains National Park is comprised of ridges of forest straddling the border between North Carolina and Tennessee. This Park consists of more than 500,000 acres and attracts the largest number of visitors annually to any national park.

#### 3.7.4.2 Assessment

As explained in section 2, VISTAS identified the $SO_2$ AoI for class I areas in the VISTAS region and neighboring regions, including Great Smoky Mountains National Park. The AoI for this class I area is shown in Figure 34.

The AoI contained 189 units that were projected to contribute to the sulfate at Great Smoky Mountains National Park, including 6 units in Virginia. Table 32 provides the calculated $SO_2$ point source contributions by state to the park.

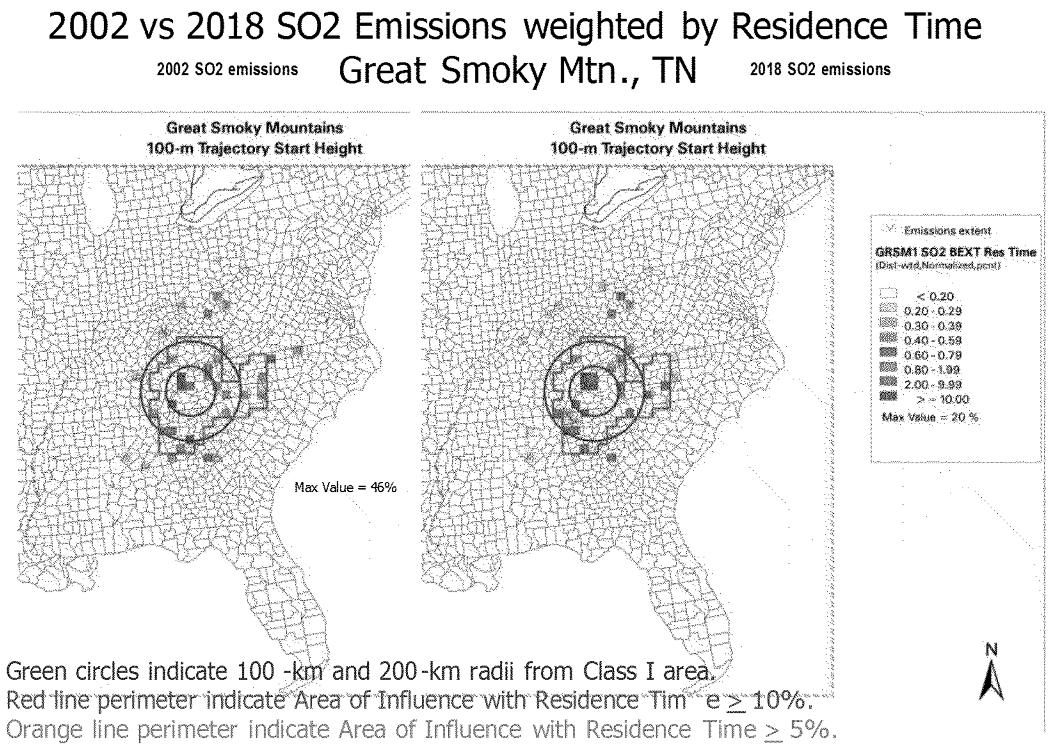


**Figure 34: Great Smoky Mountains 2002 and 2018 AOI Plots**

**Table 32: 2018 Calculated $SO_2$ Point Source Contributions by State to Great Smoky Mountains**

| State | Relative Contribution | State | Relative Contribution |
|---|---|---|---|
| Alabama | 3.12% | South Carolina | 2.44% |
| Georgia | 7.74% | Tennessee | 74.50% |
| Kentucky | 1.02% | Virginia | 2.34% |
| North Carolina | 7.43% | West Virginia | 0.54% |
| Ohio | 0.87% | | |

Thirty-seven units were projected to have a relative contribution of at least 0.5% and contribute 82.33% to sulfate, three of which are located in Virginia. These three units are located at the Clinch River Power Station, Plant ID 51-167-00003. The units at this facility are expected to either switch fuels from coal to natural gas or retire by 2018, as noted in Table 19 and section 3.2.7. Eleven units were projected to have a relative contribution of at least 1.0% and contribute 65.02% to sulfate. None of these units are located in Virginia. As shown in Figure 35 and Figure 36, which provide the glide path information as well as measured data for the 20% worst visibility days and the 20% best visibility days at Great Smoky Mountains National Park, this class I area is on track to achieve its RPG in 2018.

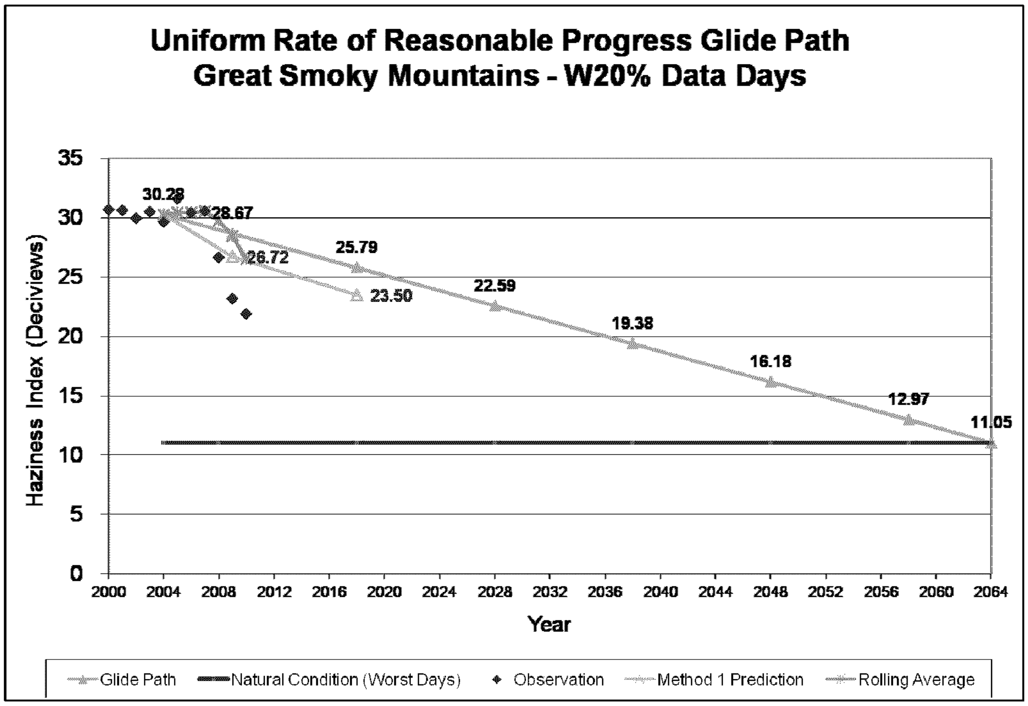


Figure 35: Glide Path for Great Smoky Mountains on 20% Worst Days

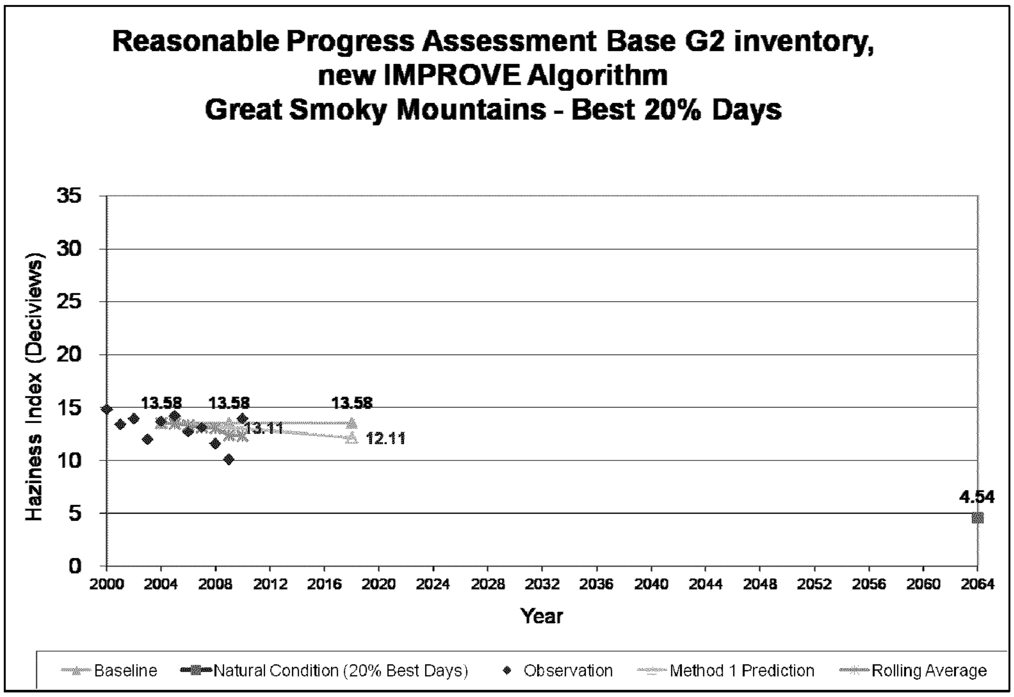


Figure 36: Glide Path for Great Smoky Mountains on 20% Best Days

### 3.7.5. *Linville Gorge, North Carolina*

#### 3.7.5.1 Description

One of the most scenic river gorges in the eastern United States, the Linville River carves the rugged, steep-walled gorge for approximately 12 miles. Within the gorge, the river drops a dramatic 2,000 feet before leveling out in the Catawba Valley. East of the gorge is Jonas Ridge; west is Linville Mountain. The gorge's rim extends 3,400 feet, compared to the river's average of 2,000 feet.

#### 3.7.5.2 Assessment

As explained in section 2, VISTAS identified the $SO_2$ AoI for class I areas in the VISTAS region and neighboring regions, including Linville Gorge National Park. The AoI for this class I area is shown in Figure 37.

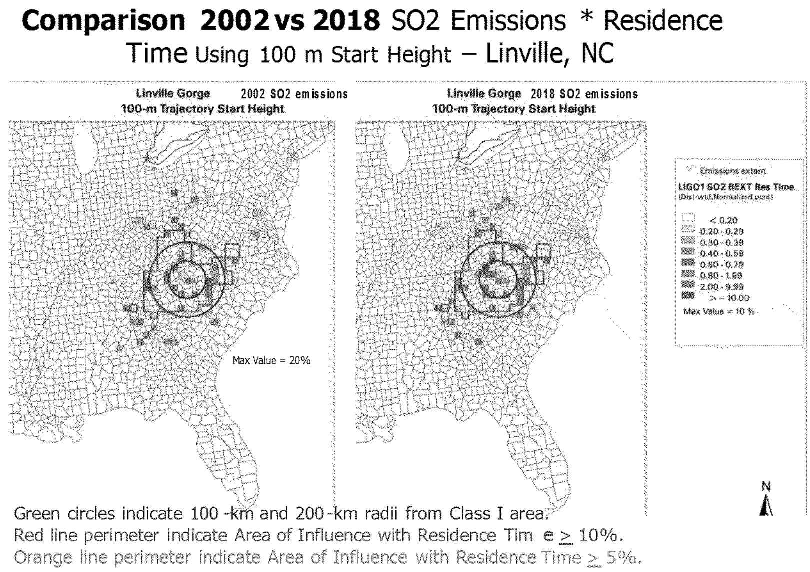


**Figure 37: Linville Gorge 2002 and 2018 AOI Plots**

The AoI contained 205 units that were projected to contribute to the sulfate at Linville Gorge National Park, including 24 units in Virginia. Table 33 provides the calculated $SO_2$ point source contributions by state to the park.

**Table 33: 2018 Calculated $SO_2$ Point Source Contributions to Linville Gorge by State**

| State | Relative Contribution | State | Relative Contribution |
|---|---|---|---|
| Alabama | 1.35% | South Carolina | 3.93% |
| Georgia | 1.98% | Tennessee | 36.28% |
| Kentucky | 0.90% | Virginia | 16.52% |
| North Carolina | 34.75% | West Virginia | 2.52% |
| Ohio | 1.76% | | |

Thirty-five units were projected to have a relative contribution of at least 0.5% and contribute 75.49% to sulfate, five of which are located in Virginia. Three of these five units are located at the Clinch River Power Station, Plant ID 51-167-00003. One of these units is located at Glen

Lyn Power Station, Plant ID 51-071-0002. The units at these facilities are expected to either switch fuels from coal to natural gas or retire by 2018, as noted in Table 19 and section 3.2.7. Eighteen units were projected to have a relative contribution of at least 1.0% and contribute 63.24% to sulfate. Three of these units are located in Virginia, at Clinch River Power Station. As shown in Figure 38 and Figure 39, which provide the glide path information as well as measured data for the 20% worst visibility days and the 20% best visibility days at the park, this area is on track to achieve its RPG in 2018.

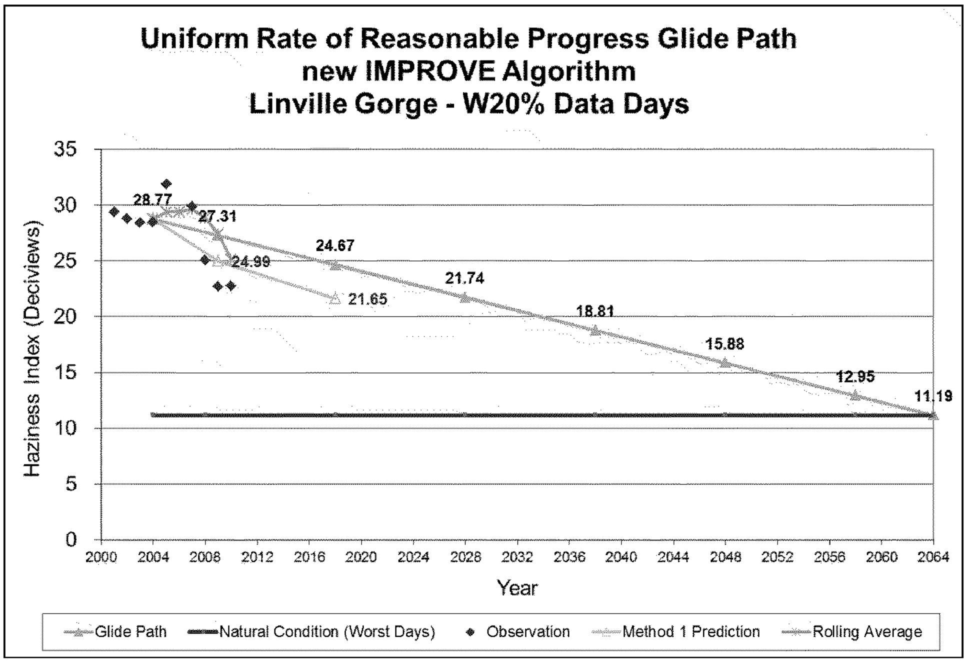


**Figure 38: Glide Path for Linville Gorge on 20% Worst Days**

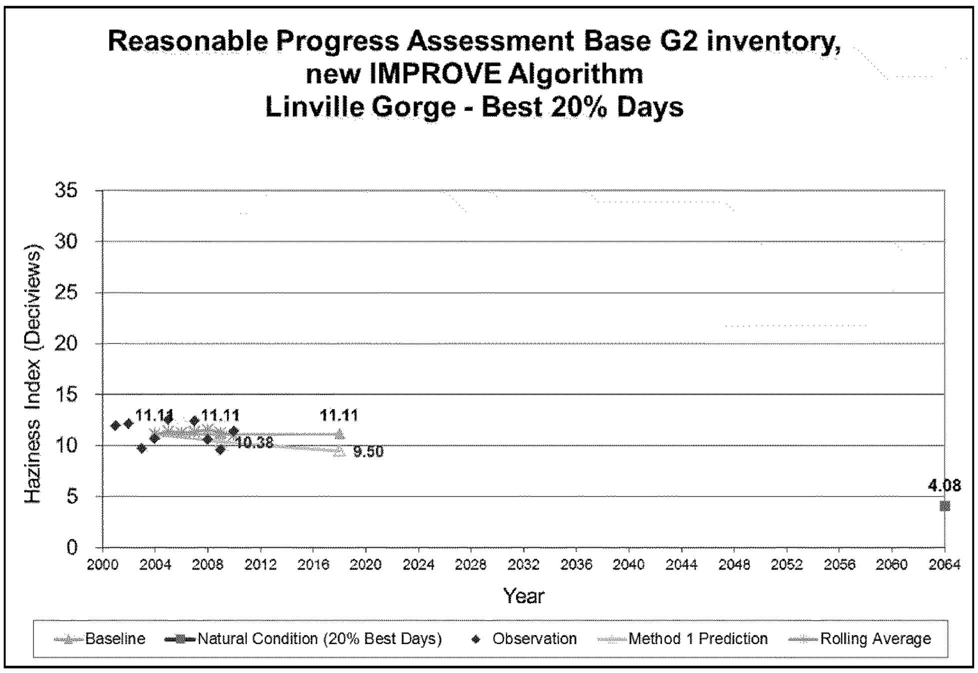


**Figure 39: Glide Path for Linville Gorge on 20% Best Days**

### *3.7.6. Cohutta Wilderness Area, Georgia*

#### 3.7.6.1 Description

Most of mountainous Cohutta Wilderness Area lies in Georgia and within the Cohutta Wildlife Management Area. Although loggers worked through 70% of the forest between 1915 and 1930, oak and pine have all but reclaimed the forest.

#### 3.7.6.2 Assessment

As explained in section 2, VISTAS identified the $SO_2$ AoI for class I areas in the VISTAS region and neighboring regions, including Cohutta Wilderness Area. The AoI for this class I area is shown in Figure 40.

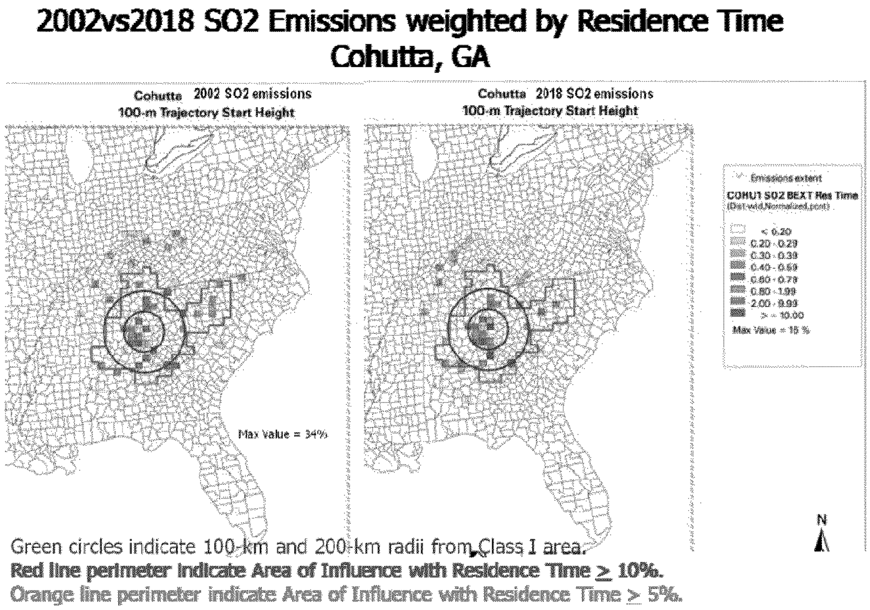


**Figure 40: Cohutta 2002 and 2018 AOI Plots**

The AoI contained 265 units that were projected to contribute to the sulfate at Cohutta Wilderness Area, including three units in Virginia. These three units are located at the Clinch River Power Station, Plant ID 51-167-00003. The units at this facility are expected to either switch fuels from coal to natural gas or retire by 2018, as noted in Table 19 and section 3.2.7. Table 34 provides the calculated $SO_2$ point source contributions by state to the area.

**Table 34: 2018 Calculated $SO_2$ Point Source Contributions by State to Cohutta**

| State | Relative Contribution | State | Relative Contribution |
|---|---|---|---|
| Alabama | 18.78% | South Carolina | 3.99% |
| Georgia | 37.60% | Tennessee | 31.43% |
| Indiana | 0.41% | Virginia | 0.62% |
| Kentucky | 1.73% | West Virginia | 0.35% |
| North Carolina | 5.09% | | |

Thirty-seven units were projected to have a relative contribution of at least 0.5% and contribute 69.80% to sulfate, none of which are located in Virginia. Twenty-six units were projected to have a relative contribution of at least 1.0% and contribute 62.50% to sulfate. As shown in Figure 41 and Figure 42, which provide the glide path information as well as measured data for the 20% worst visibility days and the 20% best visibility days at Cohutta Wilderness Area, this class I area is on track to achieve its RPG in 2018.

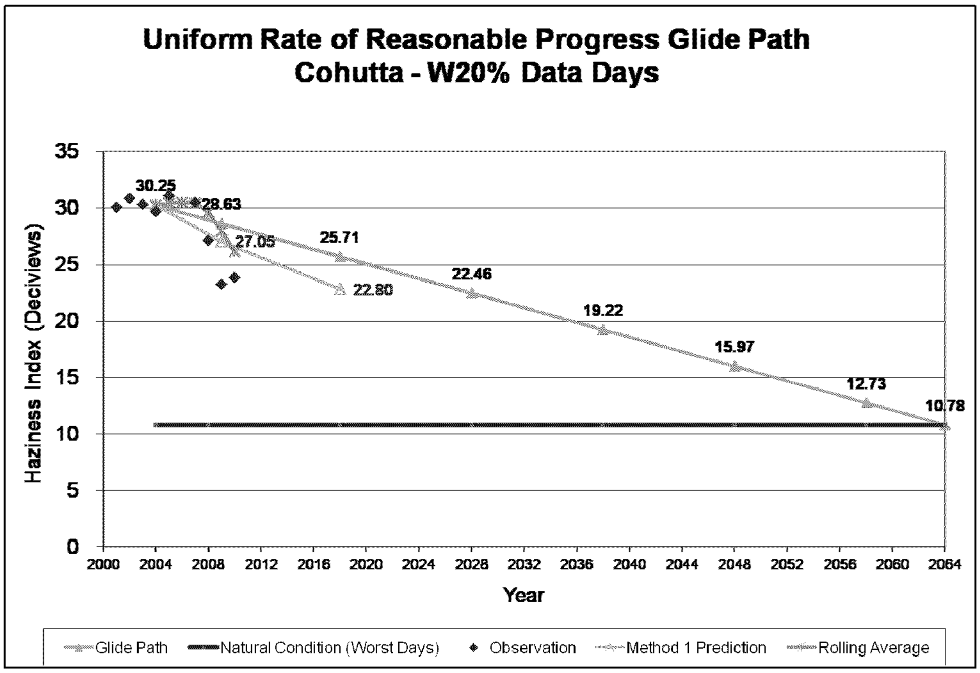


Figure 41: Glide Path for Cohutta on 20% Worst Days

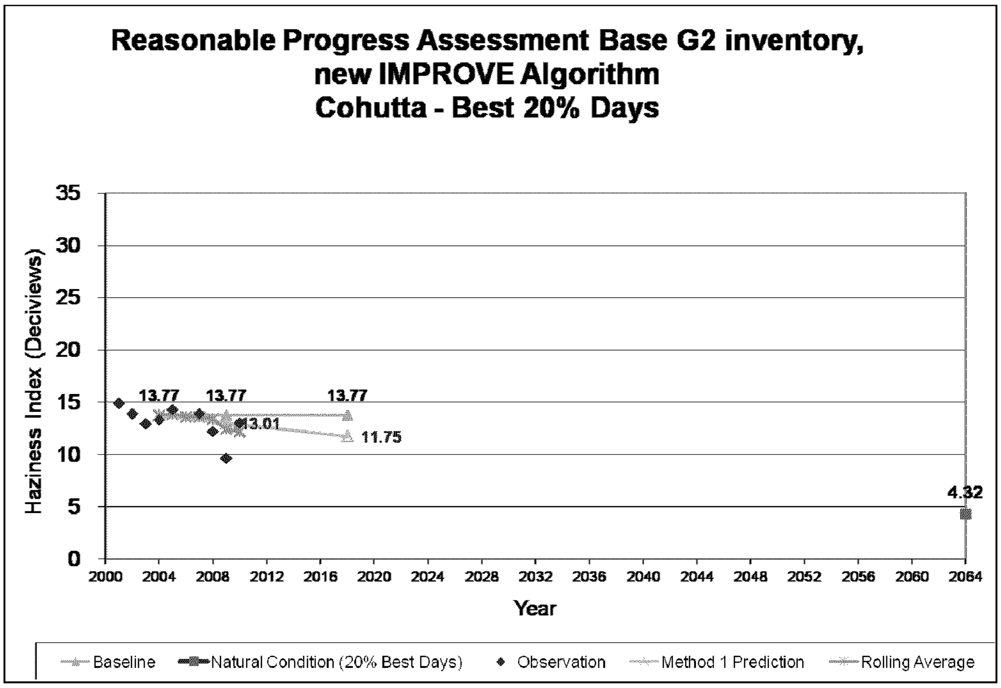


Figure 42: Glide Path for Cohutta on 20% Best Days

## 3.7.7. *Joyce Kilmer-Slickrock Wilderness Area, North Carolina and Tennessee*

### 3.7.7.1 Description

This area contains an ancient, old growth forest of giant trees, many of which are over 400 years old and reach 100 feet in height. Of the present 17,013 acres in the Slickrock Wilderness Area, 3,840 acres have been dedicated as a memorial forest.

### 3.7.7.2 Assessment

As explained in section 2, VISTAS identified the $SO_2$ AoI for class I areas in the VISTAS region and neighboring regions, including Joyce Kilmer-Slickrock Wilderness Area. The AoI for this class I area is shown in Figure 43.

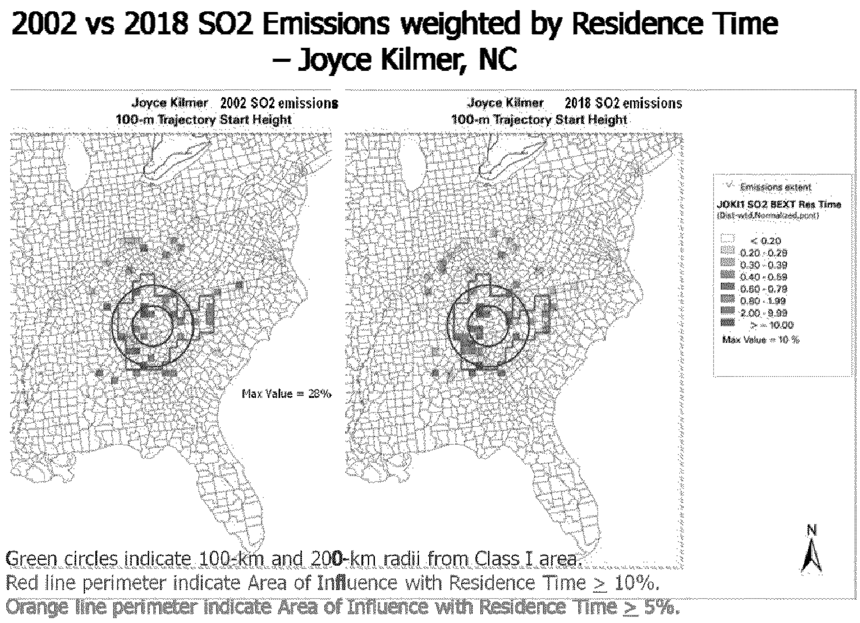


**Figure 43: Joyce Kilmer-Slickrock 2002 and 2018 AoI Plots**

The AoI contained 173 units that were projected to contribute to the sulfate at Joyce Kilmer-Slickrock Wilderness Area, including four units in Virginia. Three of these four units are located at the Clinch River Power Station. The units at this facility are expected to either switch fuels from coal to natural gas or retire by 2018, as noted in Table 19 and section 3.2.7. Table 35 provides the calculated $SO_2$ point source contributions by state to the area.

**Table 35: 2018 Calculated $SO_2$ Point Source Contribution by State to Joyce Kilmer-Slickrock**

| State | Relative Contribution | State | Relative Contribution |
|---|---|---|---|
| Alabama | 6.53% | South Carolina | 5.14% |
| Georgia | 20.46% | Tennessee | 55.87% |
| Kentucky | 1.38% | Virginia | 1.53% |
| North Carolina | 9.08% | | |

Forty-five units were projected to have a relative contribution of at least 0.5% and contribute 78.32% to sulfate, three of which are located in Virginia. These three are the units located at

Clinch River. Sixteen units were projected to have a relative contribution of at least 1.0% and contribute 59.82% to sulfate. None of these units are located in Virginia.

Joyce Kilmer-Slickrock Wilderness Area shares a visibility monitor with the Great Smoky Mountains National Park. Therefore, this assessment refers to the glide path analyses performed for the Great Smoky Mountains National Park. As shown in Figure 35 and Figure 36, which provide the glide path information as well as measured data for the 20% worst visibility days and the 20% best visibility days at the Great Smoky Mountains National Park, the area is on track to achieve its RPG in 2018.

### *3.7.8. Cape Romaine Wilderness Area, South Carolina*

#### 3.7.8.1 Description

The Cape Romain National Wildlife Refuge stretches for 22 miles along the coastline of South Carolina. The refuge consists of open water, sandy beaches, and saltwater marshes.

#### 3.7.8.2 Assessment

As explained in section 2, VISTAS identified the $SO_2$ AoI for class I areas in the VISTAS region and neighboring regions, including Cape Romain Wilderness Area. The AoI for this class I area is shown in Figure 44.

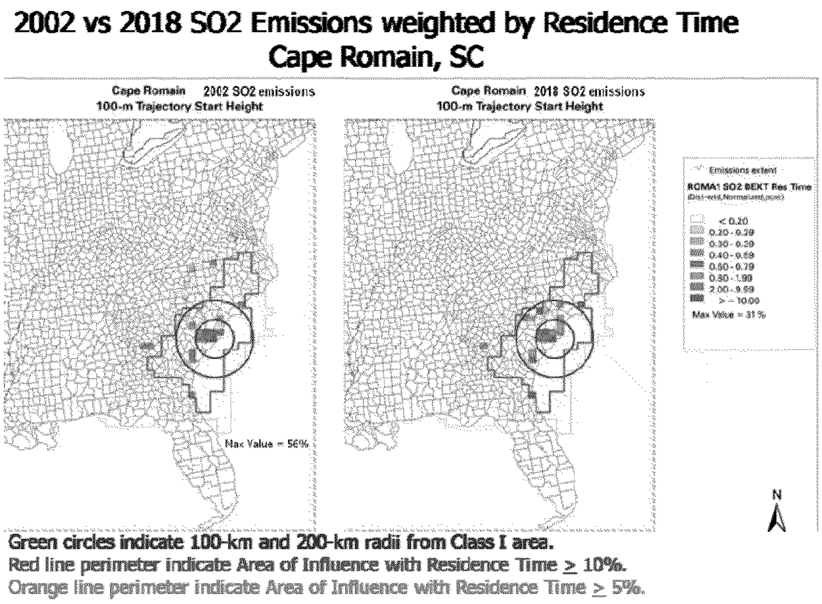


**Figure 44: Cape Romain 2002 and 2018 AOI Plots**

The AoI contained 199 units that were projected to contribute to the sulfate at Cape Romain Wilderness Area, including eight units in Virginia. Table 36 provides the calculated $SO_2$ point source contributions by state to the area.

**Table 36: 2018 Calculated $SO_2$ Point Source Contribution to Cape Romain by State**

| State | Relative Contribution | State | Relative Contribution |
|---|---|---|---|
| Alabama | 0.07% | South Carolina | 86.98% |
| Florida | 1.82% | Tennessee | 0.08% |
| Georgia | 6.52% | Virginia | 0.35% |
| North Carolina | 4.19% | | |

Thirty-six units were projected to have a relative contribution of at least 0.5% and contribute 83.02% to sulfate, none of which are located in Virginia. Twenty-one units were projected to have a relative contribution of at least 1.0% and contribute 71.62% to sulfate. As shown in Figure 45 and Figure 46, which provide the glide path information as well as measured data for the 20% worst visibility days and the 20% best visibility days at Cape Romain Wilderness Area, this class I area is on track to achieve its RPG in 2018 for the 20% worst days, and shows no degradation in visibility on the 20% best days.

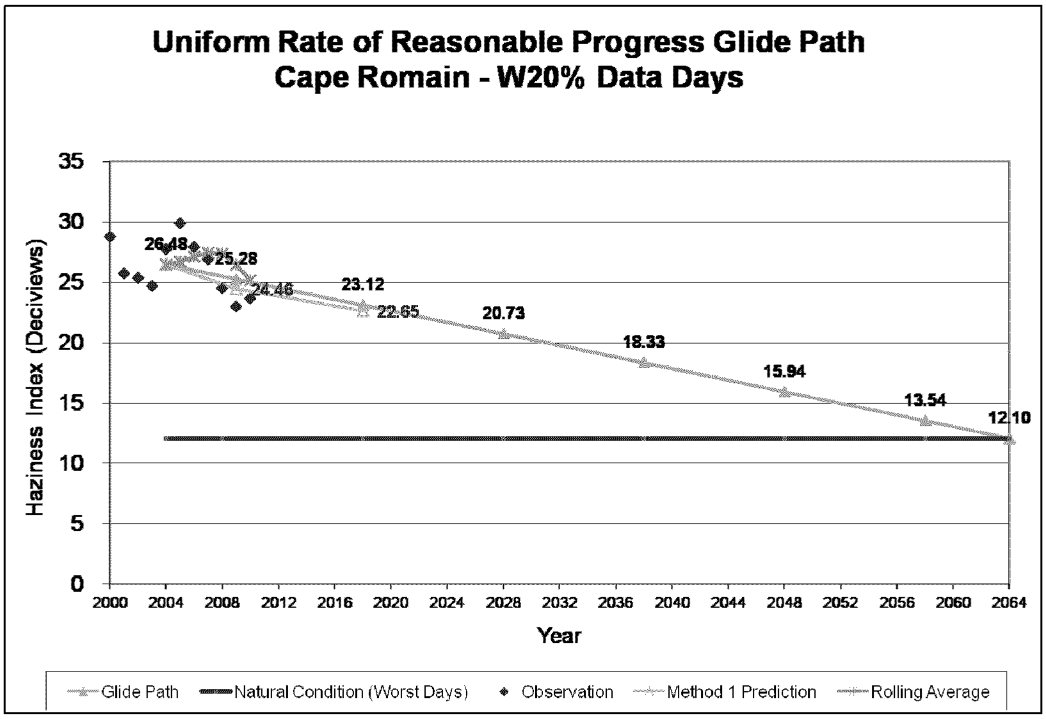


**Figure 45: Glide Path for Cape Romain on 20% Worst Days**

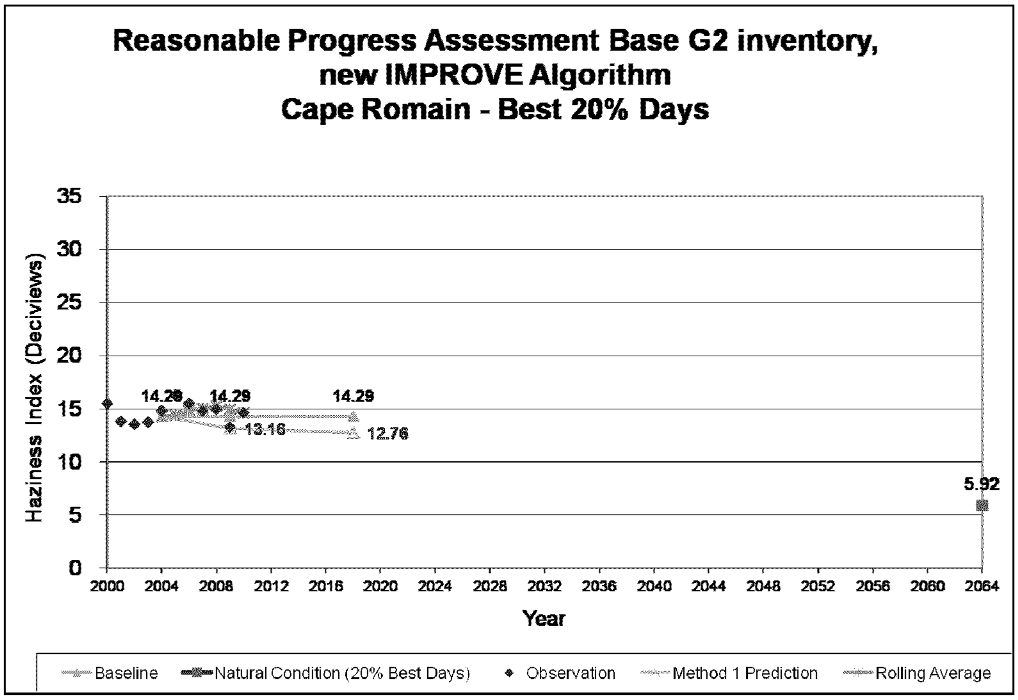


**Figure 46: Glide Path for Cape Romain on 20% Best Days**

### *3.7.9. Shining Rock Wilderness Area, North Carolina*

#### 3.7.9.1 Description

Designated as a wilderness area in 1963, Shining Rock encompasses over 18,000 acres. This area has elevations varying from 3300 to over 6,000 feet and lies on the north slope of the Pisgah Ledge, a northeasterly extension of the Blue Ridge Mountains. The very steep and rugged terrain of the area includes five mountain peaks that rise above 6,000 feet.

#### 3.7.9.2 Assessment

As explained in section 2, VISTAS identified the $SO_2$ AoI for class I areas in the VISTAS region and neighboring regions, including Shining Rock Wilderness Area. The AoI for this class I area is shown in Figure 47.

The AoI contained 229 units that were projected to contribute to the sulfate at Shining Rock Wilderness Area, including 15 units in Virginia. Table 37 provides the calculated $SO_2$ point source contributions by state to Shining Rock Wilderness Area.

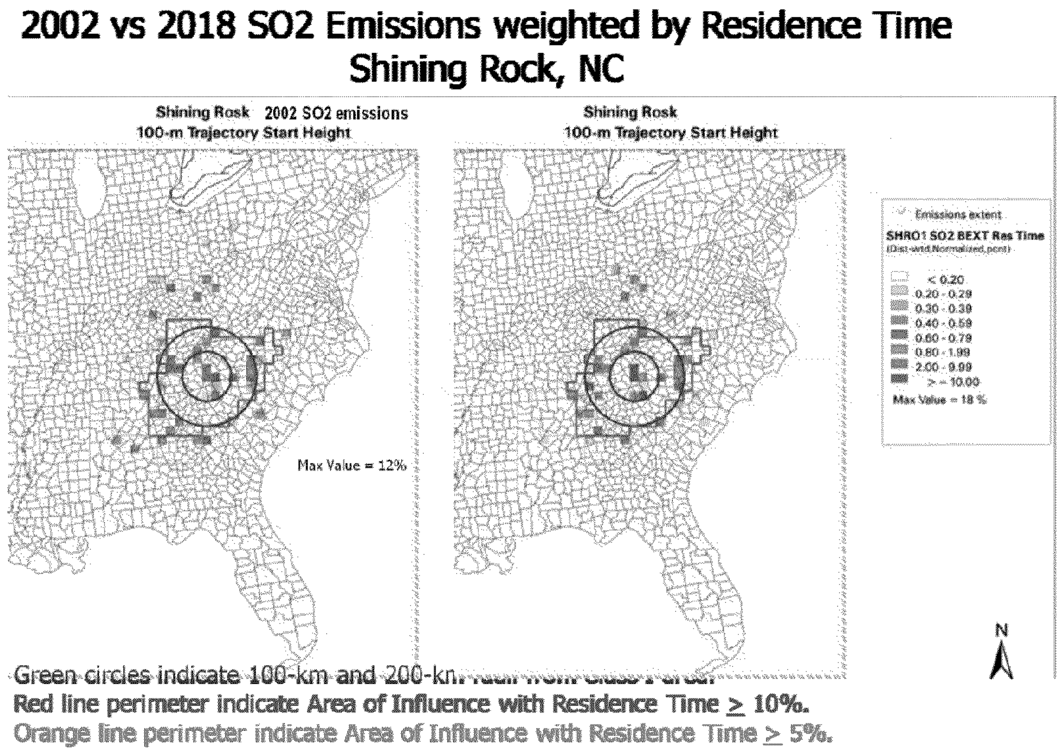


**Figure 47: 2002 and 2018 AoI Plots for Shining Rock**

**Table 37: 2018 Calculated $SO_2$ Point Source Contribution by State to Shining Rock**

| State | Relative Contribution | State | Relative Contribution |
|---|---|---|---|
| Alabama | 1.84% | South Carolina | 14.89% |
| Georgia | 7.22% | Tennessee | 12.19% |
| Kentucky | 0.81% | Virginia | 2.95% |
| North Carolina | 58.84% | West Virginia | 0.63% |
| Ohio | 0.67% | | |

Thirty units were projected to have a relative contribution of at least 0.5% and contribute 80.89% to sulfate, three of which are located in Virginia. These three units are located at the Clinch River Power Station. The units at this facility are expected to either switch fuels from coal to natural gas or retire by 2018, as noted in Table 19 and section 3.2.7. Seventeen units were projected to have a relative contribution of at least 1.0% and contribute 71.95% to sulfate. As shown in Figure 48 and Figure 49, which provide the glide path information as well as measured data for the 20% worst visibility days and the 20% best visibility days at Shining Rock Wilderness Area, this class I area is on track to achieve its RPG in 2018 for the 20% worst days and on the 20% best days.

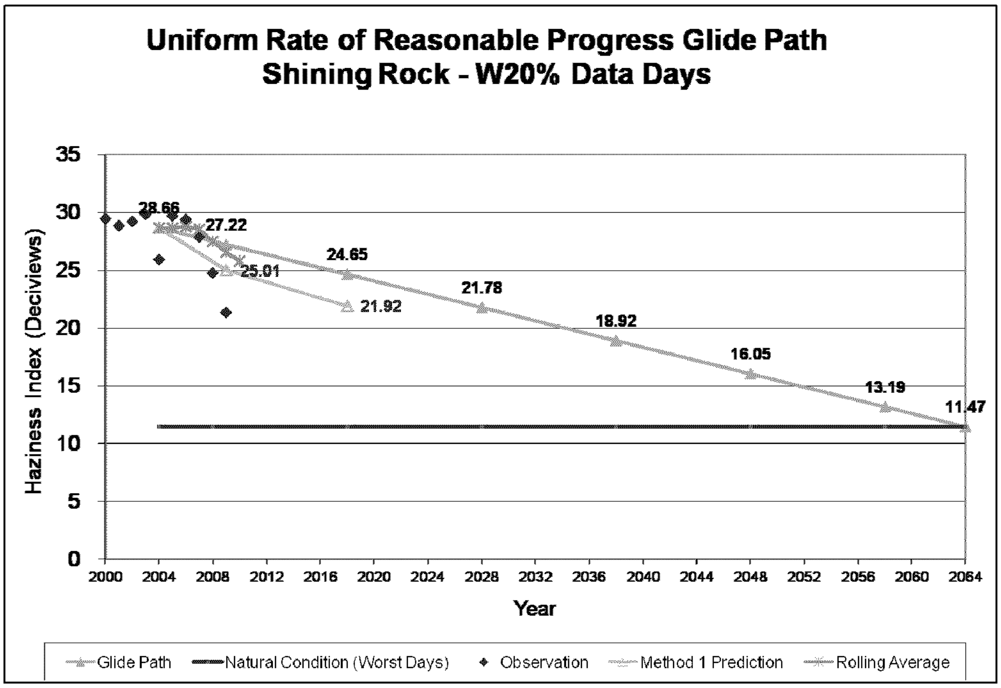


Figure 48: Glide Path for Shining Rock on 20% Worst Days

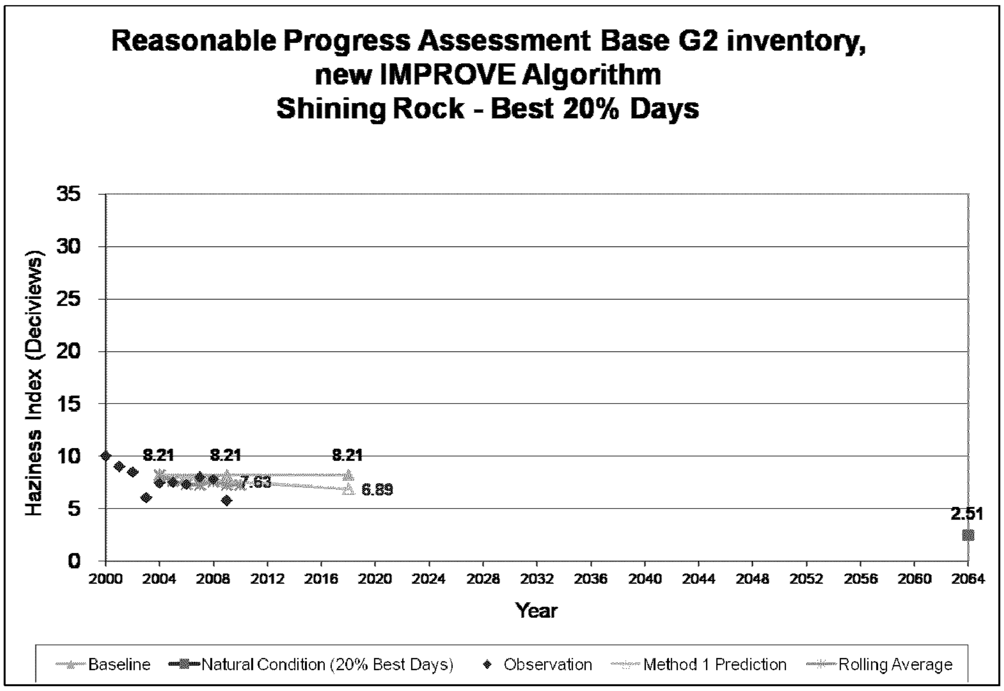


Figure 49: Glide Path for Shining Rock on 20% Best Days

*3.7.10. Swanquarter Wilderness Area, North Carolina*

### 3.7.10.1 Description

Established in 1932, Swanquarter Wilderness Area, a satellite of Mattamuskeet National Wildlife Refuge, encompasses islands and coastal marshland on the north side of Pamlico Sound. Access to most of Swanquarter Refuge requires a boat, and along the mainland, the area is approximately half estuarine and half upland forest.

### 3.7.10.2 Assessment

As explained in section 2, VISTAS identified the $SO_2$ AoI for class I areas in the VISTAS region and neighboring regions, including Swanquarter Wilderness Area. The AoI for this class I area is shown in Figure 50.

The AoI contained 255 units that were projected to contribute to the sulfate at Swanquarter Wilderness Area, including 59 units in Virginia. Table 38 provides the calculated $SO_2$ point source contributions by state to Swanquarter Wilderness Area.

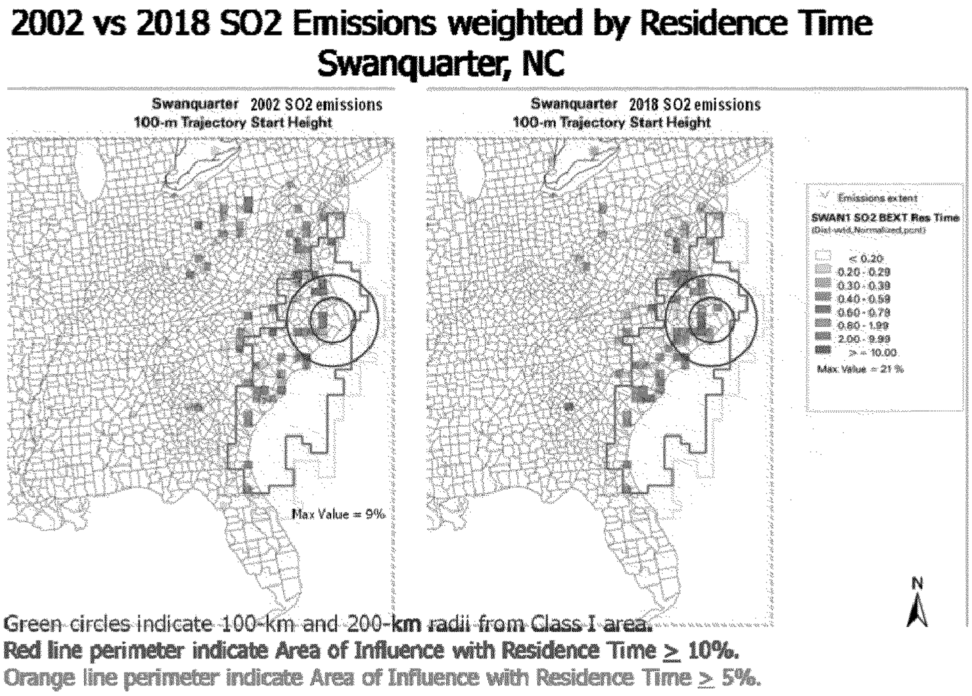


**Figure 50: 2002 and 2018 AoI Plots for Swanquarter**

**Table 38: 2018 Calculated $SO_2$ Point Source Contributions by State to Swanquarter**

| State | Relative Contribution | State | Relative Contribution |
|---|---|---|---|
| Delaware | 2.83% | New Jersey | 1.10% |
| Florida | 2.35% | North Carolina | 58.69% |
| Georgia | 3.34% | Pennsylvania | 0.50% |
| Kentucky | 0.10% | South Carolina | 15.35% |
| Maryland | 1.34% | Virginia | 13.78% |
| | | West Virginia | 0.63% |

Forty-seven units were projected to have a relative contribution of at least 0.5% and contribute 67.31% to sulfate, four of which are located in Virginia. Two of these four units are located at International Paper's Franklin Mill. This facility stopped using coal as its main fuel in the 2010 timeframe, which will lower actual emissions from the facility. Resumption of the use of coal as a fuel source would require a significant amendment to the facility's Title V permit as well as a control technology review. The other two units are EGUs, Unit 4 at Chesapeake Power Station and Unit 1 at Yorktown Power Station. The coal-fired units at these facilities are expected to retire by 2018, as noted in Table 19 and section 3.2.7. Twenty units were projected to have a relative contribution of at least 1.0% and contribute 48.89% to sulfate. As shown in Figure 51 and Figure 52, which provide the glide path information as well as measured data for the 20% worst visibility days and the 20% best visibility days at Swanquarter Wilderness Area, this class I area is beneath the uniform rate of progress for the 20% worst days and shows no degradation in visibility on the 20% best days.

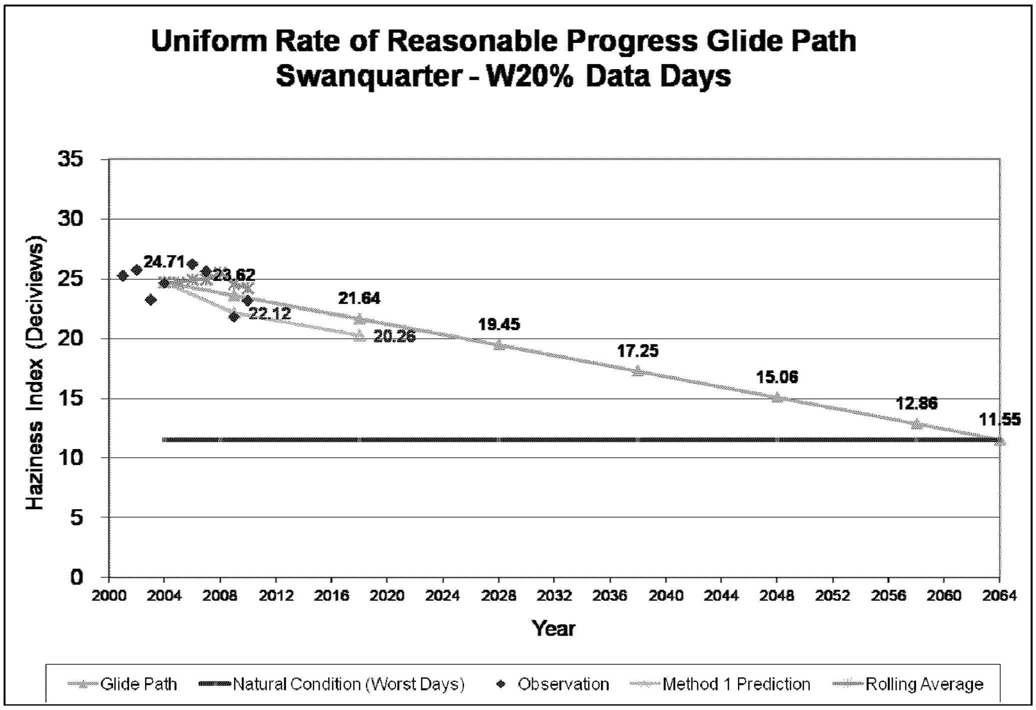

Figure 51: Glide Path for Swanquarter on 20% Worst Days

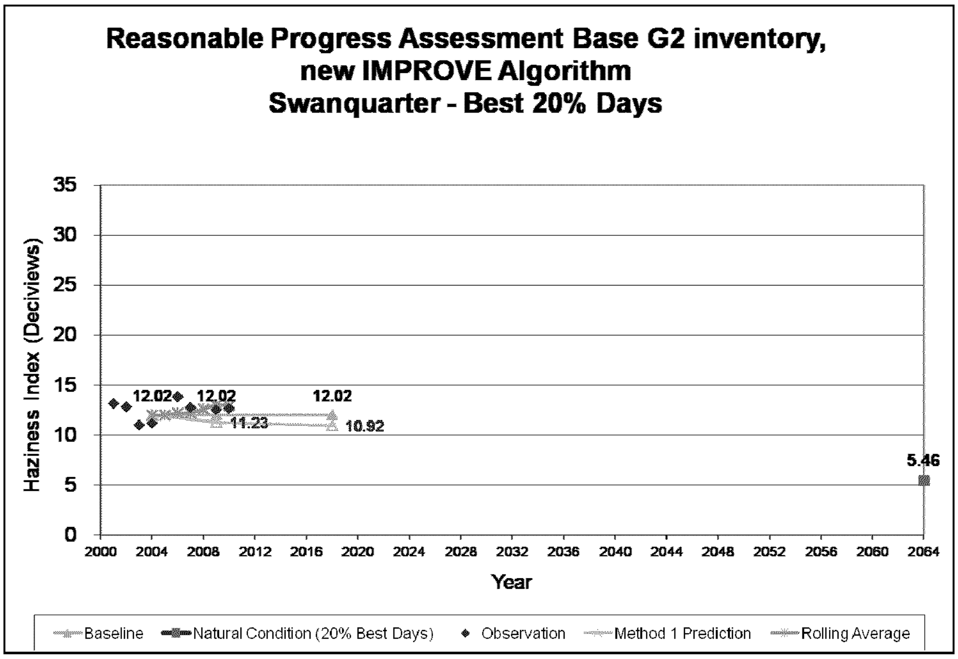


Figure 52: Glide Path for Swanquarter on 20% Best Days

### *3.7.11. Wolf Island Wilderness Area, Georgia*

#### 3.7.11.1 Description

The refuge was established in 1930 as a migratory bird sanctuary. It consists of a long, narrow strip of oceanfront beach backed by a broad band of salt marsh. Over 75% of the refuge's 5,126 acres are composed of saltwater marshes.

#### 3.7.11.2 Assessment

As explained in section 2, VISTAS identified the $SO_2$ AoI for class I areas in the VISTAS region and neighboring regions, including the Wolf Island Wilderness Area. The AoI for this class I area is shown in Figure 53.

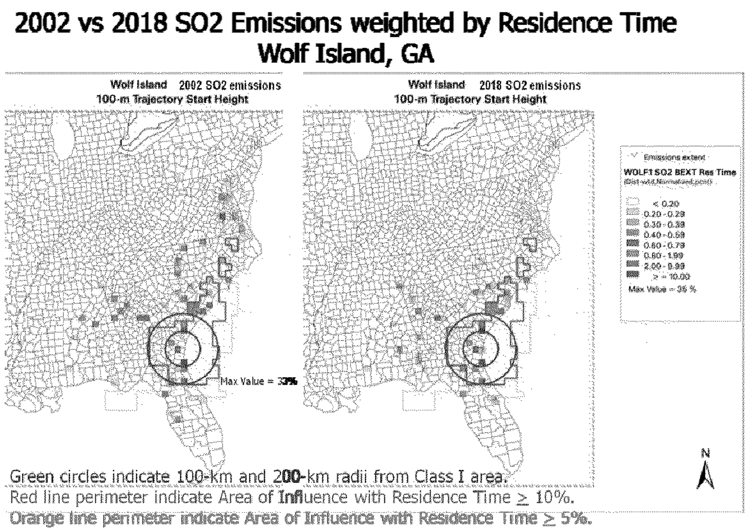


Figure 53: 2002 and 2018 AoI Plots for Wolf Island

The AoI contained 156 units that were projected to contribute to the sulfate at Wolf Island Wilderness Area, including one unit in Virginia. Table 39 provides the calculated $SO_2$ point source contributions by state to Wolf Island Wilderness Area. Thirty-two units were projected to have a relative contribution of at least 0.5% and contribute 79.17% to sulfate while 18 units were projected to have a relative contributio n of at least 1.0% and contribute 69.06% to sulfate. None of these units are located in Virginia.

**Table 39: 2018 Calculated $SO_2$ Point Source Contributions to Wolf Island**

| State | Relative Contribution | State | Relative Contribution |
|---|---|---|---|
| Alabama | 0.75% | North Carolina | 2.92% |
| Delaware | 0.25% | South Carolina | 13.83% |
| Florida | 43.33% | Virginia | 0.11% |
| Georgia | 38.82% | | |

Wolf Island Wilderness Area shares a visibility monitor with the Okefenokee Wilderness Area. Therefore, this assessment refers to the glide path analyses performed for the Okefenokee Wilderness Area. As shown in Figure 54 and Figure 55, which provide the glide path information as well as measured data for the 20% worst visibility days and the 20% best visibility days at the Okefenokee Wilderness Area, the Wolf Island Wilderness Area is on track to achieve its RPG in 2018 and shows no degradation in visibility on the 20% best days.

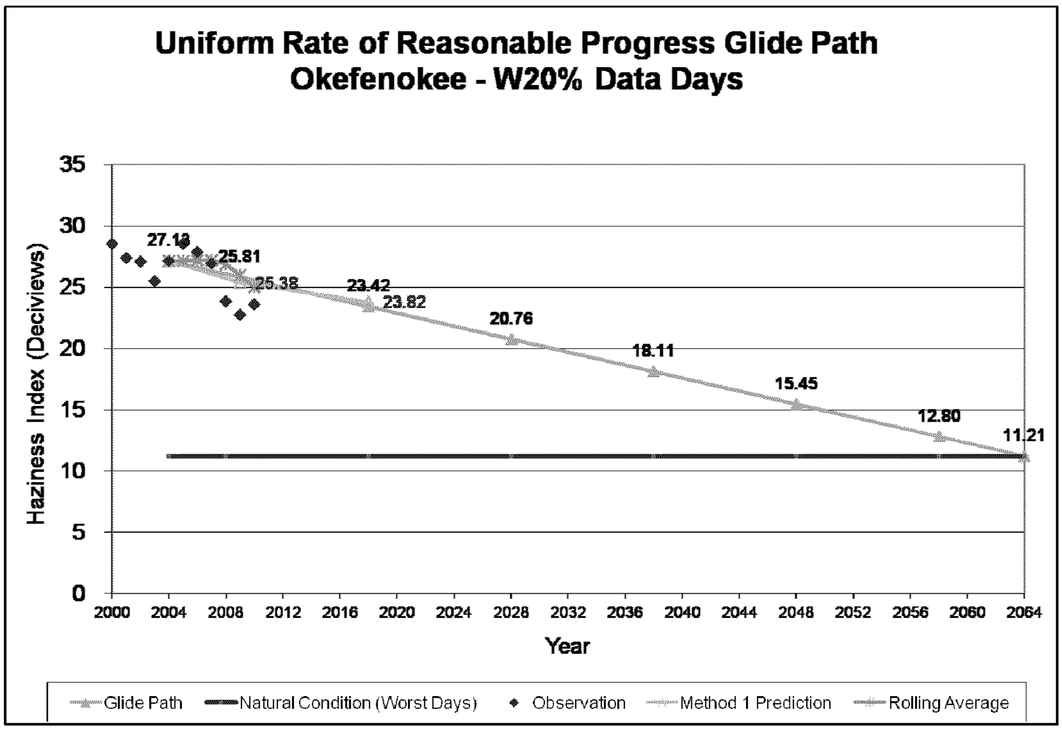


**Figure 54: Glide Path for Okefenokee on 20% Worst Days**

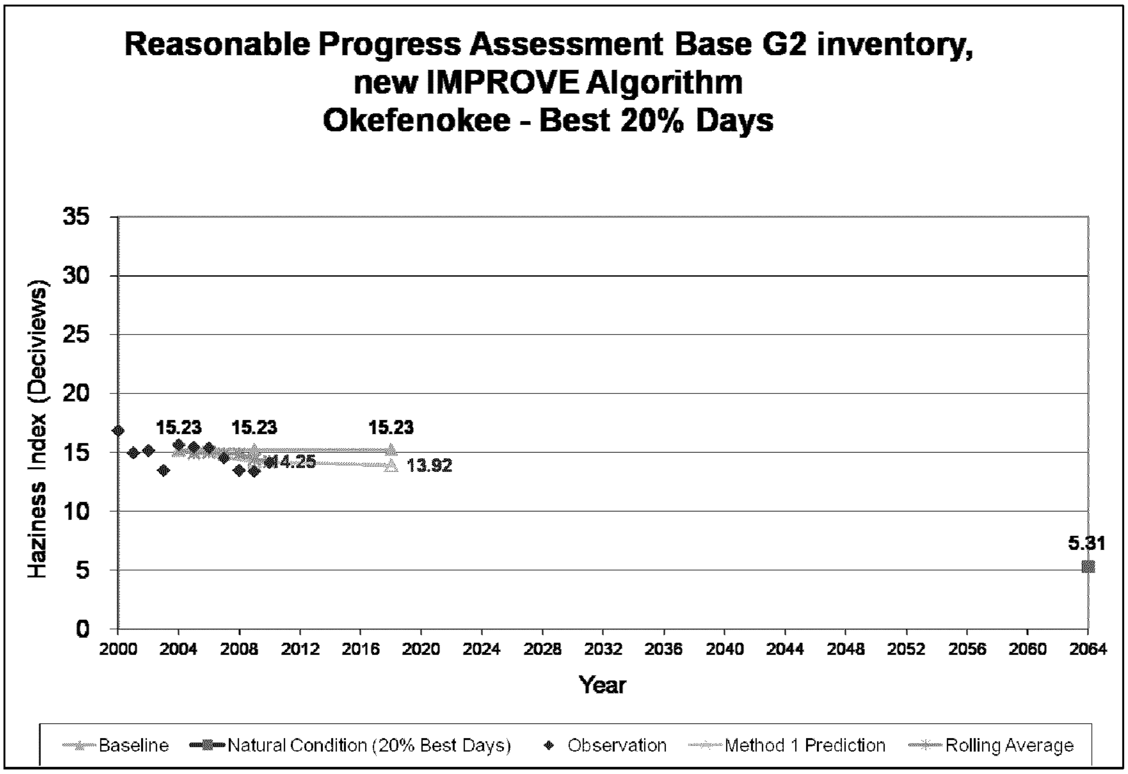


**Figure 55: Glide Path for Okefenokee on 20% Best Days**

### *3.7.12. Brigantine Wilderness Area, New Jersey*

#### 3.7.12.1 Description

Brigantine Wilderness is located in southern New Jersey on the Atlantic Coast. The 6,600 acre wilderness area includes salt marsh, beach, and dune, with a small area of hardwood.

#### 3.7.12.2 Assessment

As explained in section 2, VISTAS identified the $SO_2$ Areas of Influence for class I areas in the VISTAS region and neighboring regions, including the Brigantine Wilderness. The AoI for Brigantine is shown in Figure 56.

There were 278 units identified within the AoI which were projected to contribute to the sulfate at Brigantine, including 69 units in Virginia. Table 40 provides the calculated $SO_2$ point source contributions by state to Brigantine Wilderness Area.

Twenty-five units were projected to have a relative contribution of at least 0.5% and contribute 70.68% to sulfate, one of which is located in Virginia. This unit is Unit 5 at Dominion Possum Point Power Station. Unit 5 is a large, residual oil-fired boiler. IPM predicts that this unit will be retired by 2018 although Dominion's IRP does not corroborate this prediction. The unit has become less utilized since 2002, and while not expected to be retired, the unit is expected to be lightly utilized in the future. Ten units were projected to have a relative contribution greater than 1.0% and contribute 59.86% to sulfate, none of which are located in Virginia. As shown in Figure 57 and Figure 58, which provide the glide path information as well as measured data for the 20% worst visibility days and the 20% best visibility days at Brigantine Wilderness Area, this class I area is on track to achieve its RPG in 2018 for the 20% worst days and shows no degradation in visibility on the 20% best days,

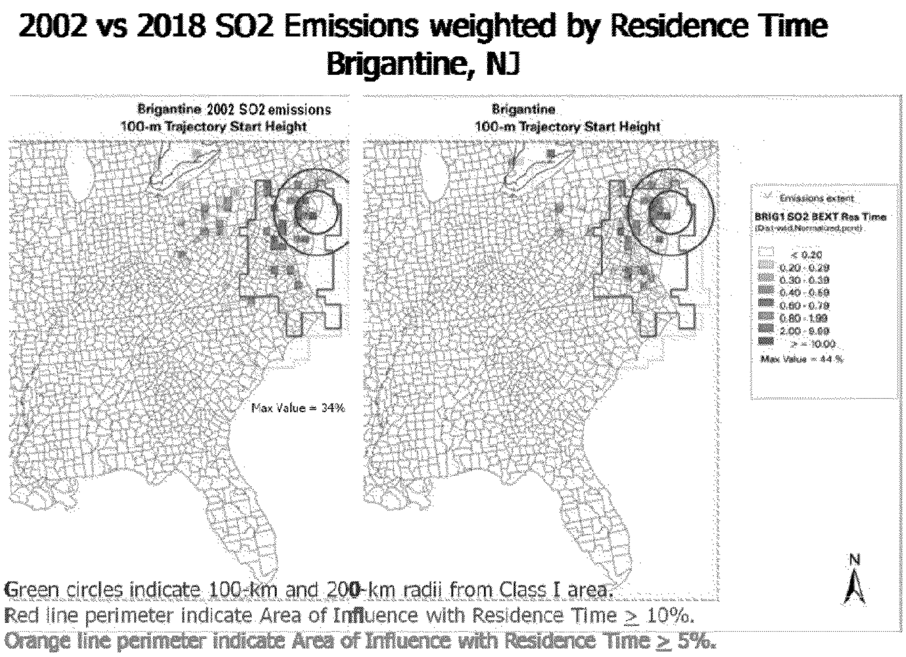


**Figure 56: 2002 and 2018 AoI for Brigantine**

**Table 40: 2018 Calculated $SO_2$ Point Source Contributions to Brigantine**

| State | Relative Contribution | State | Relative Contribution |
|---|---|---|---|
| Connecticut | 0.05% | North Carolina | 0.75% |
| Washington DC | 0.05% | Ohio | 0.52% |
| Delaware | 27.83% | Pennsylvania | 13.63% |
| Maryland | 7.67% | Virginia | 7.90% |
| New Jersey | 40.11% | West Virginia | 0.94% |
| New York | 0.56% | | |

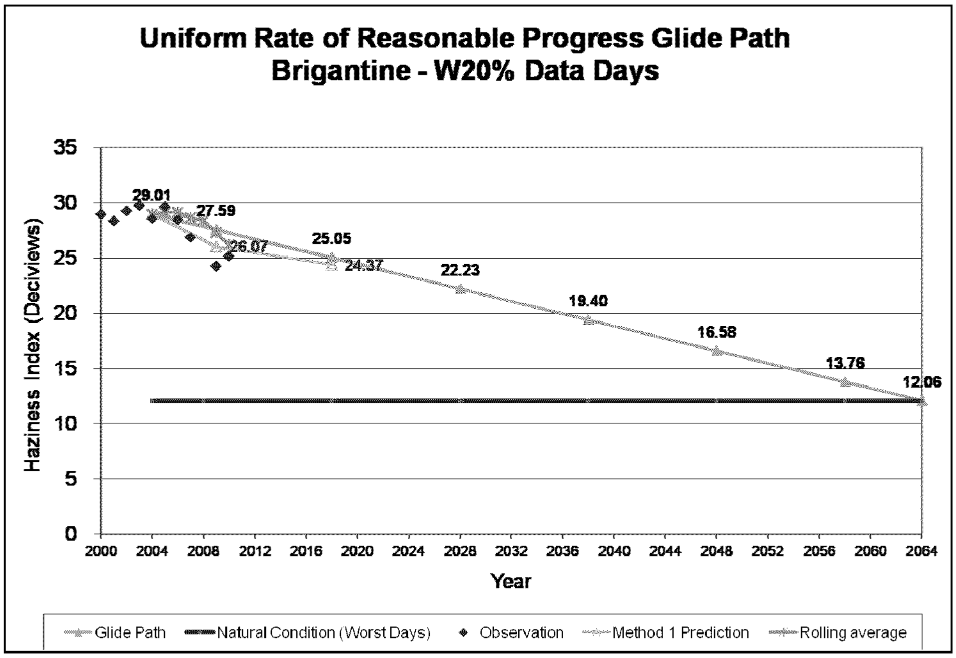


**Figure 57: Glide Path for Brigantine on 20% Worst Days**

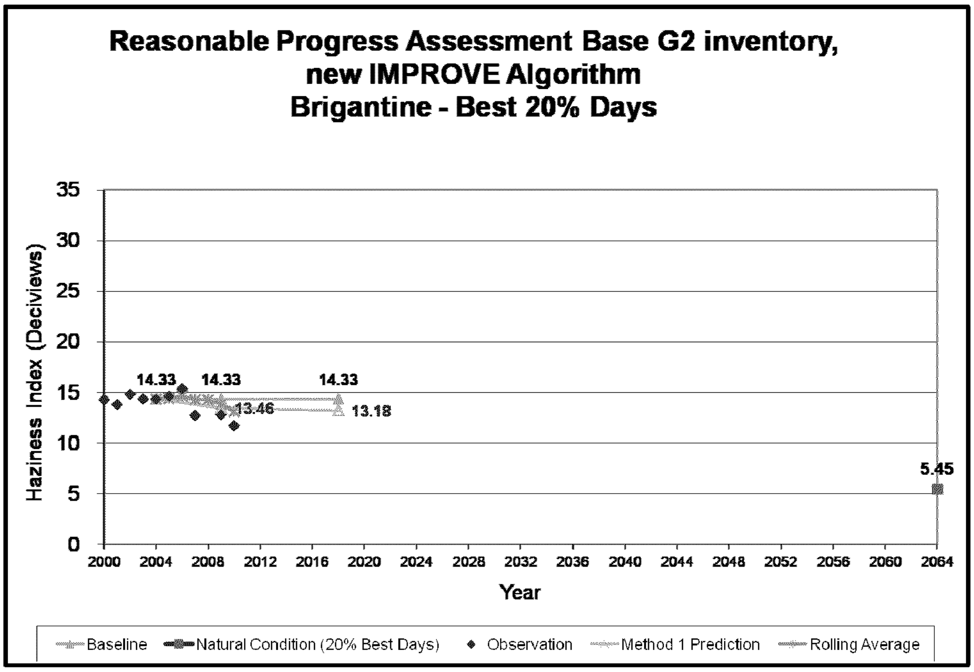


**Figure 58: Glide Path for Brigantine on 20% Best Days**

## 3.8. Assessment of Monitoring Strategies

40 CFR 51.308(g)(7) of the RHR requires:

> A review of the state's visibility monitoring strategy and any modifications to the strategy as necessary.



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The primary monitoring network for regional haze, both nationwide and in Virginia, is the IMPROVE network. Given that IMPROVE monitoring data from 2002-2004 served as the baseline for the regional haze program, the future regional haze monitoring strategy must necessarily be based on, or directly comparable to, IMPROVE. The IMPROVE measurements provide the only long-term record available for tracking visibility improvement or degradation. Therefore, Virginia intends to rely on the IMPROVE network for complying with the regional haze monitoring requirement in the RHR.

Two IMPROVE sites are operating in Virginia, as shown in Figure 59. These are located at James River Face Wilderness Area and Shenandoah National Park. The IMPROVE measurements are central to Virginia's regional haze monitoring strategy, and the objectives listed in previous sections could not be met without the monitoring provided through IMPROVE. Any reduction in the scope of the IMPROVE network in Virginia would jeopardize the Commonwealth's ability to demonstrate reasonable progress toward visibility improvement. In particular, Virginia's regional haze strategy relies on emission reductions that will result from CAIR or the CAIR replacement rule and emissions reductions in neighboring states, which will occur at different times and will most likely not be spatially uniform. Continued monitoring at both class I areas is important to document the air quality impacts of the emissions reductions. Monitoring at every class I area is important, but it is especially important to document the different air quality responses to the emissions reductions at sites like those in Virginia that are located in complex terrain. Therefore, Virginia expects EPA to maintain support for the IMPROVE network at least equal to current levels.

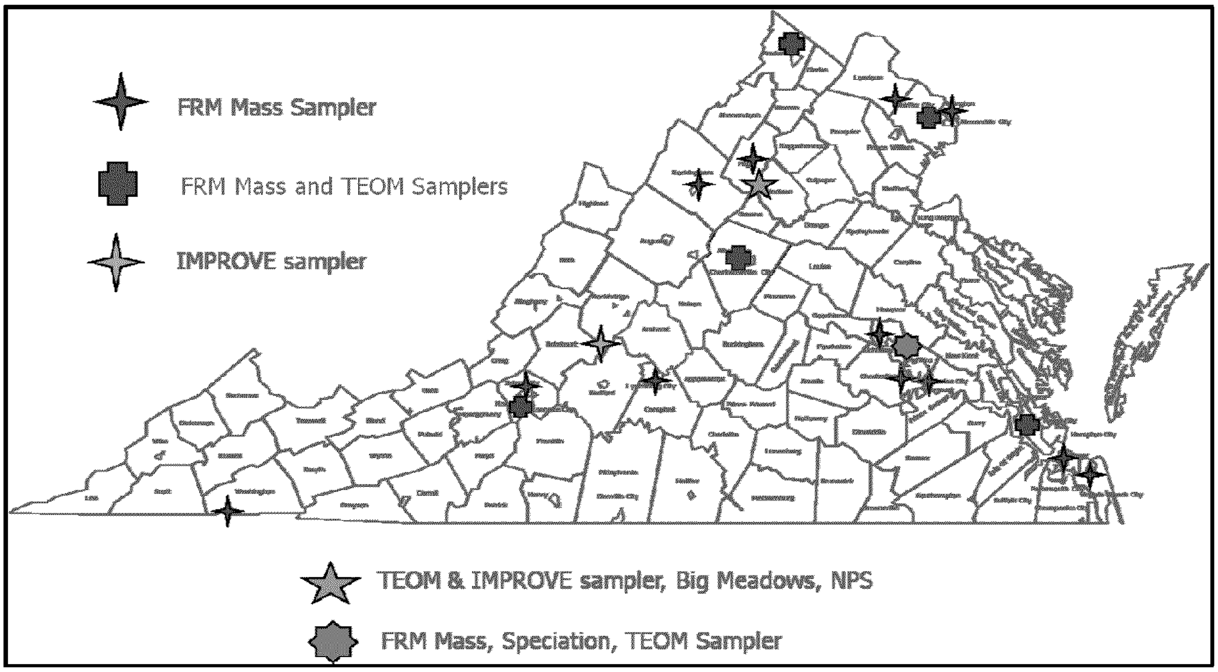


**Figure 59: Virginia $PM_{2.5}$ Monitoring Network and IMPROVE Network, as of April 2012**

The IMPROVE network is periodically assessed to optimize the data acquisition versus the required resources. The current IMPROVE monitors in Virginia, particularly the monitor located at Shenandoah National Park, have extensive data records that represent unique airsheds, and reducing the IMPROVE network by shutting down either monitoring site would significantly impede tracking progress at the affected class I area.

In the event that either monitoring site at the James River Face Wilderness Area or Shenandoah National Park is proposed for elimination, Virginia, in consultation with EPA and relevant FLMs, will seek to develop an alternative approach for meeting the tracking obligation, perhaps by seeking contingency funding to carry out limited monitoring or by relying on data from other monitoring sites to demonstrate trends in the reduction of concentrations of the contributors to visibility impairment. Such alternative monitoring approaches are unlikely to be sufficient to meet the RHR data requirements.

Data produced by the IMPROVE monitoring network will be used as the basis for preparation of the five-year progress reports and the ten-year SIP revisions, each of which relies on analysis of the preceding five years of data. Consequently, the monitoring data from the IMPROVE sites needs to be readily accessible and as up-to-date as possible. Presumably, IMPROVE will continue to process information from its own measurements at about the same pace and with the same attention to quality as shown in the recent past. The VIEWS website has been supported by VISTAS and the other RPOs to provide ready access to the IMPROVE data and data analysis tools. Therefore, Virginia is encouraging VISTAS and other RPOs to maintain support of VIEWS or an equivalent data management system to facilitate analysis of the IMPROVE and visibility-related data.

In addition to the IMPROVE measurements, some ongoing, long-term, limited monitoring supported by FLMs may provide insight into progress toward regional haze goals. Virginia benefits from the data from these measurements but is not responsible for the funding decisions to maintain these measurements into the future. Such long-term monitoring includes web cameras operated at the class I areas.

Moreover, Virginia operates a robust $PM_{2.5}$ network, as shown in Figure 59. Using the federal reference method, $PM_{2.5}$ 24-hour mass samplers collect particulate matter across the Commonwealth. Some of these stations collect 24-hour samples every day while others operate on a one-in-three day schedule. Virginia collects speciated $PM_{2.5}$ data at one site in Henrico County, using two co-located samplers that operate simultaneously. Data are collected on a one-in-three day sampling schedule at this site. Virginia also operates several $PM_{2.5}$ continuous monitors that allow data compilations into hourly averages. These different types of $PM_{2.5}$ measurements help to characterize air pollution levels in areas across the Commonwealth and therefore aid in the analysis of visibility improvement in and near the class I areas.

# 4. Adequacy of the Existing SIP

40 CFR 51.308(h) states:

(h) *Determination of the adequacy of existing implementation plan.* At the same time the State is required to submit a 5-year progress report to EPA in accordance with paragraph (g) of this section, the State must also take one of the following actions based upon the information presented in the progress report:

(1) If the State determines that the existing implementation plan requires no further substantive revision at this time in order to achieve established goals for visibility improvement and emissions reductions, the State must provide to the Administrator a negative declaration that further revision of the existing implementation plan is not needed at this time.

(2) If the State determines that the implementation plan may be inadequate to ensure reasonable progress due to emissions from sources in another State(s) which participated in a regional haze planning process, the State must provide notification to the Administrator and to the other State(s) which participated in the regional planning process with the States. The State must also collaborate with the other State(s) through the regional haze planning process for the purpose of developing additional strategies to address the plan's deficiencies.

(3) Where the State determines that the implementation plan is or may be inadequate to ensure reasonable progress due to emissions from sources in another country, the State shall provide notification, along with available information, to the Administrator.

(4) Where the State determines that the implementation plan is or may be inadequate to ensure reasonable progress due to emissions form sources within the State, the State shall revise its implementation plan to address the plan's deficiencies within one year.

Based on the options above and the information presented in this document, the Commonwealth of Virginia proposes a negative declaration to the EPA Administrator, specifying that no additional controls are necessary during this five-year progress report period. Therefore, no further revision of the existing Virginia Regional Haze SIP is needed.

In keeping with EPA's recommendations related to consultation, Virginia enlisted the support of appropriate state, local, and tribal air pollution agencies, as well as the corresponding FLMs to formulate this report. As part of this commitment, Virginia made an advanced, draft copy of this report available to these agencies and sought their input. More information on the consultation process can be found in Appendix B – Interagency Consultation.

The Commonwealth commits to continued consultation among the states and FLMs as it relates to any SIP revisions and the implementation of other programs having the potential to contribute to visibility impairment.